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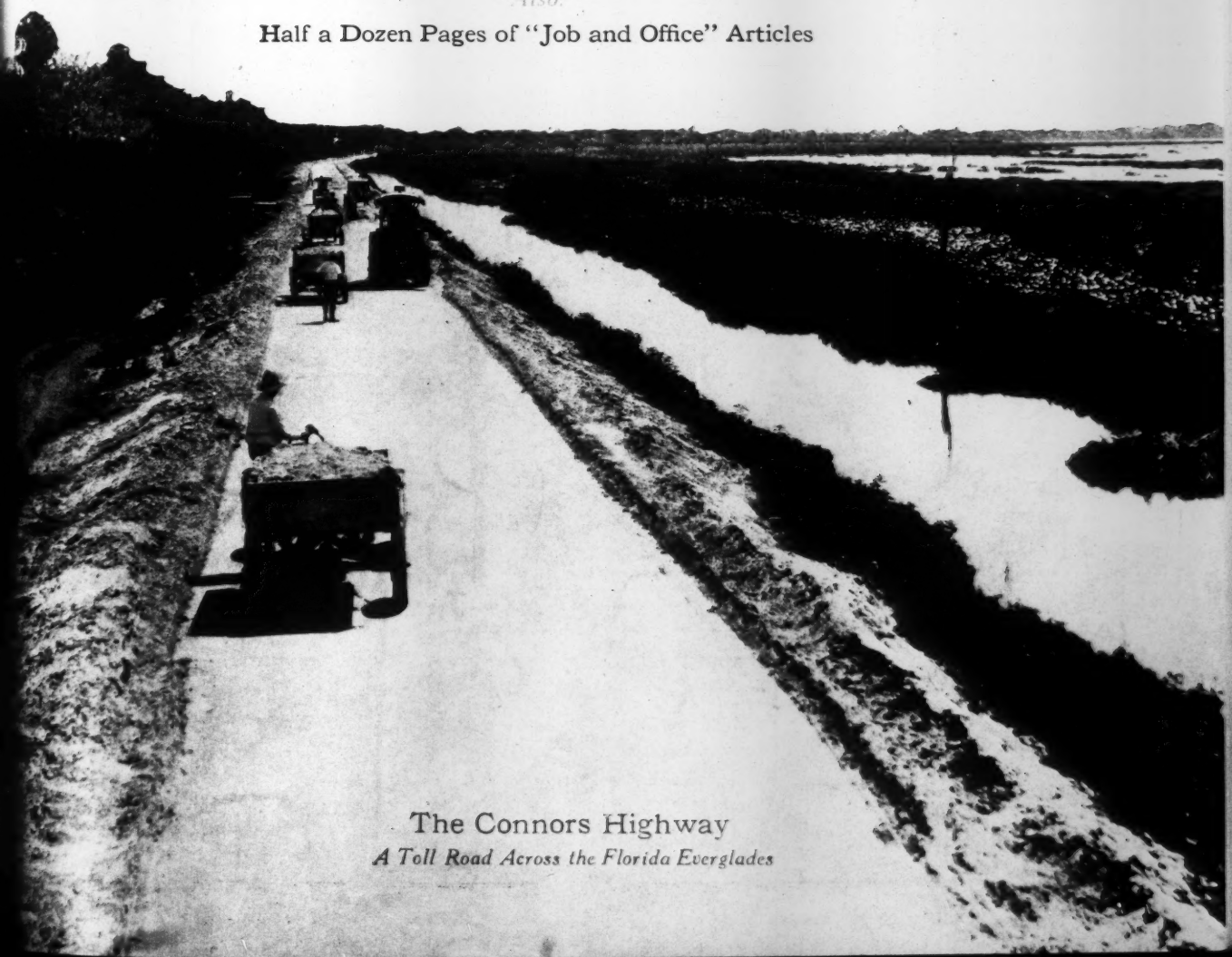

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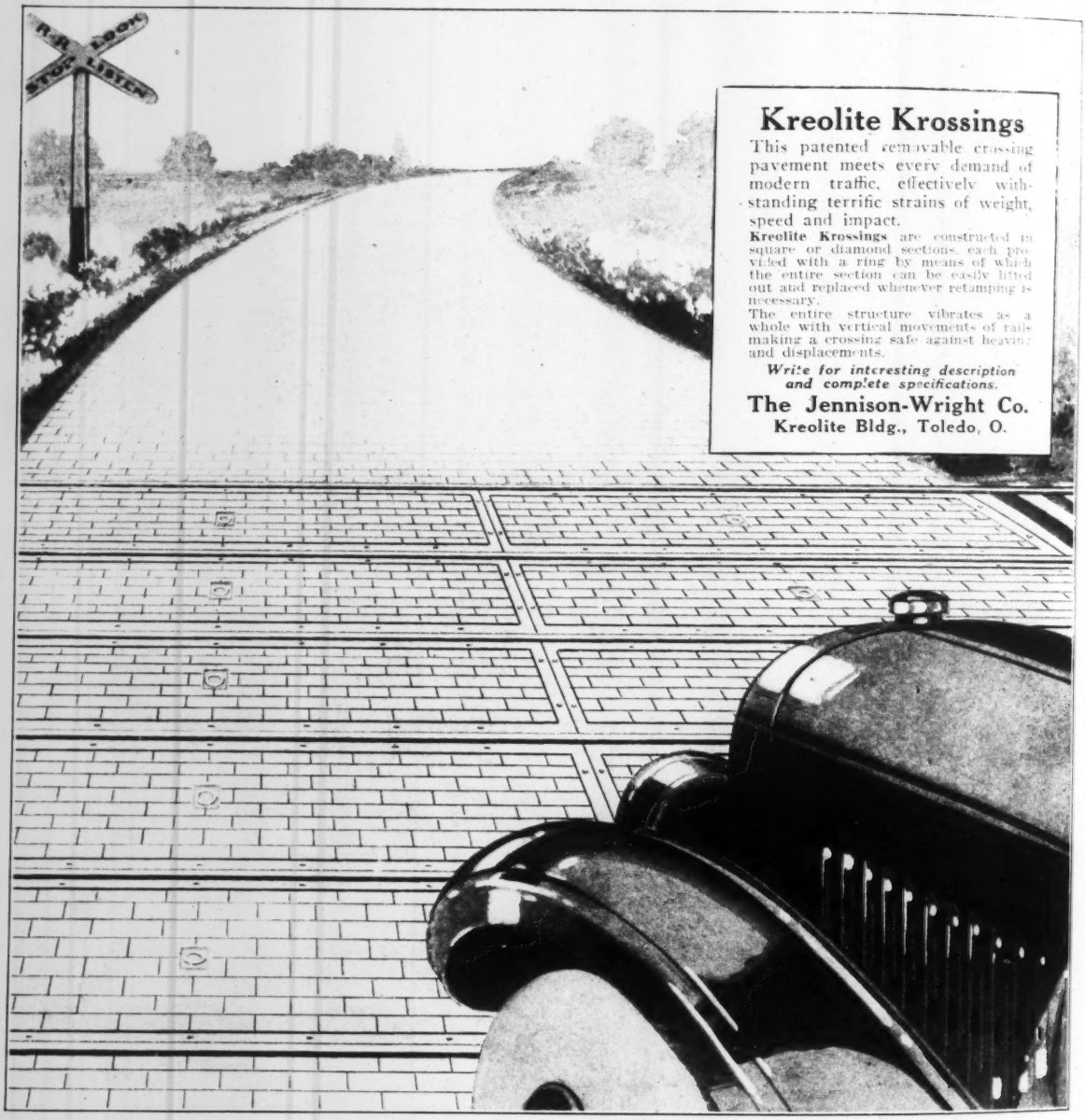

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 93 NEW YORK, SEPTEMBER 11, 1924 Number 11

A Changing World

IN THIS issue there are two articles on the European economic situation, one a first hand observation of the economic revival of Germany, the other a remarkably well-balanced and fair estimate of the future operation of the Dawes Plan, which is now an accepted thing. Although written by different persons without knowledge one of the other the two are complementary; together they give the whole picture of what we may expect from Europe for a year or so better than either does separately. We recommend that every engineer read them. Articles on the economic fate of Europe and of the world have been multiplying beyond reason since the war and most of them are too dull or too pedantic to be of interest even to a professional economist much less to one whose interest in economics lies in its effect on him and his business. But a new era is opening in post-war history, an era which is going to make a direct impress on the progress of the world and therefore upon the personal affairs of every one who works in the world. Those who are designing and planning and building the structures and services for this working world will do well to take full cognizance of the change—which our articles foretell.

Storm-Water Sewer Limits

IT IS an engineering truism that storm sweres large enough to carry the heaviest downpours would bankrupt a city. Accordingly, a limit is set on the size of such sewers based on the known or assumed frequency of precipitation at a given rate and the resulting runoff to the sewers. The governing principle is that the damage caused by the excess rainfalls and runoffs at rare and undertain intervals, can better be met by property owners or the city *as damages* than to burden the city or the property owners in an assessment district with the huge capital charges that would be required to insure freedom from damage, if certitude were indeed possible. How many and what cities keep records that enable their engineers to establish a policy in this matter or if one has been established to check its soundness? And what is or should be the policy?

One Reason for Safety Factors

BRIDGE construction has more conditions to meet than only those involved in discussions of conventional engine types, impact, and secondary stress. Its business is to produce structures able to survive through the good days and the bad, capable of weathering whatever happenings may come along. What this may mean is illustrated in a somewhat new way by two recent bridge accidents reported from the Pacific Northwest. In one case a carload of logs on a flat car became unchained while the car was crossing a bridge, and the logs striking the trusses caused a serious wreck. In the second and much stranger case a tree standing on a river bank near a bridge was undermined by flood waters, and in falling dropped across the bridge, wrecking it badly. Bridges are not designed to withstand the blow from a falling tree nor the violent forces applied to their web members when cars or loadings become displaced and swing out beyond the clearance line. Such accidents must be expected to wreck bridges sometimes. But the bridge that will survive a violent blow is quite obviously a better bridge than the one that fails; and since it is the bridge engineer's task to build structures that will carry traffic without interruption for many years, he must so far as reasonably possible design for abnormal as well as normal service. Low safety margins and precise calculation of service stresses are most excellent matters, but provisions for the unforeseen must be made in addition. How this sometimes works out is illustrated by what happened on another railroad a year or two ago, when the loading of a car shifted and struck the trusses at the entering end of an important bridge. The blow after damaging the end post cut clean through the hip vertical and the adjoining main diagonal; yet with its main truss system thus destroyed, the span held up by virtue of the stiffness of its joints, and saved the train from wrecking. Traffic was interrupted only long enough for the span to be shored up, after which the damaged members could be replaced. Ample design and large safety margins held up this bridge rather than precise analysis of stresses.

An Unfair Document

IN THE "Letters to the Editor" section of this issue are published in full the replies that Lt. Col. Sherrill, of the Corps of Engineers, has made to the two societies whose committees condemned him for his charges of graft under the civilian administrators of camp construction during the late war. Those letters show that Colonel Sherrill still labors under the misapprehension that this journal remarked in its editorial "Reckless Words," in the issue of Aug. 14, that is that the report of the Graham Committee is admissable evidence. That report was made by a partisan committee of Congress just before the presidential campaign of 1920 and bears every earmark of partisan politics. Its findings have been discredited every time they have been brought into court; it is a document which no fair-minded man would ever use either in proof or disproof of anything it purports to cover. That Colonel Sherrill should submit it even as an indication of the way of truth and at the same time disregard the fact that every legal effort to prove the criminality alleged in the report has failed shows that he is pleading as an attorney would and not considering facts as an engineer should.

Using the Other Fellow's Time

TO RUN its technical sessions on schedule is the laudable ambition of every up-to-date engineering society, but how few are successful. Because so many authors are either incapable of saying what they have to say in an assigned time or are so self-centered as to

think their own remarks of more importance than those of their fellows most technical meetings are unbalanced, either by lack of discussion or by disproportionate assumption of time. Conditions are better today than they used to be because the evil has become so marked that every program committee realizes it and endeavors by assignment of time to lay out each session with fair treatment of each subject and with proper discussion. But even with that the best laid plans go astray because of the aforementioned authorial selfishness or, what is equally common, too good natured chairmanship. The ideal chairman is ruthless; subject only to the expressed desire of the floor, he should restrain verbosity and insist on schedule observance. His obligation is as much to the bored hearers or to the waiting succeeding speaker as it is to the speaker who unnecessarily occupies time, and politeness to the latter ceases to be a virtue when that politeness is at the expense of dozens or hundreds of his hearers.

Time Scheduling of Papers

THE foregoing observations have especial application to a new method of program scheduling which the American Concrete Institute purposes using at its convention next February. Each session is to be made up of seven 20-minute units. Before the program is prepared each participant will be assigned a half-unit, one unit or two units as the program committee thinks necessary. In addition sufficient time is to be allotted for discussion between papers, so that at the expressed pleasure of the convention extensions of time may be allotted without infringing on any of the succeeding time allotments. Time scheduling is not new but usually it has taken the form of clock time startings for each paper and not interval allotments. The new scheme seems more workable because the chairman is not held down to the clock if perchance the schedule runs ahead or behind and is therefore not under the common necessity of either shortening some of the late assignments or, on the other hand, faking a discussion until the time for the next paper is reached. No such scheme can succeed without an able chairman, for plan as a committee will the execution of the plan remains in one man's hands. We shall see at Chicago next February whether the revised scheme works as well as it promises.

Trucks as Common Carriers

THE DEVELOPMENT of the motor truck since the enactment of the Interstate Commerce law has resulted in a peculiar condition in regard to rates which needs to be cleared up by having the present act brought up to date. The wording of the present law is such that the Interstate Commerce Commission has found it necessary to declare that motor truck transfer companies are not common carriers under the provisions of the act and consequently are not subject to jurisdiction except when they can be classed as "terminal facilities" as in the case of the truck service to "off-track stations" maintained in St. Louis and at New York, when used by a railroad for "store-door delivery," or when used for the transfer of freight from one railroad to another. But when the service is extended beyond terminal districts it becomes what is commonly known as line haul and, under the present law, is beyond the jurisdiction of the commission.

A case in point is that of the Star'n-New Haven Line, a water carrier, which, by an arrangement with private motor truck companies operating to inland points in New England, enters into competition with the New York, New Haven & Hartford R.R. and its subsidiary the New England Steamship Co., and provides a fast service which shippers are anxious to maintain. In this case the commission finds that as the motor truck companies are not subject to its jurisdiction, the Starin-New Haven Line cannot publish a through rate to southern points from points in New England, but that it may publish rates from New Haven to southern points to which can be added a statement as to the tariff from the inland point to New Haven by motor truck. But to make this service pay the trucking company's share of the combined charges must be larger than the rate for the corresponding rail haul and consequently the rate from New Haven must be lower than the rates which apply to local traffic from New Haven.

In view of this the commission has authorized the use of such rates, under certain restrictions as to evidence of the origin of the traffic at specified inland points, with the result that there are now two rates from New Haven to southern points, one a higher rate for local traffic and the other a lower rate for traffic delivered to the Starin-New Haven Line by certain motor truck companies. To be sure, the lower rate is actually a proportional rate put in effect for a combined rail, water and motor service similar to that in effect in many places for a combined rail and water service; but, due to the fact that the present law does not recognize the fact that the motor truck service exists, the rate is in effect a discrimination against freight delivered to the dock of the Starin-New Haven Line in the wagons of the local shippers in favor of that delivered at the same point by the trucks of certain motor transfer companies.

Compulsory Stops at Grade Crossings

IN HALF-A-DOZEN states today there is a law requiring automobiles to come to a dead stop before crossing a railroad at grade. There is a large body of opinion which favors universal extension of such a law in the interest of highway traffic safety. Much of the propaganda in favor of the law comes from the railroads who apparently have reached an agreement that it is desirable legislation not only from the standpoint of general safety but also in protection of themselves, but there is also much sentiment in safety movement circles in favor of the compulsory stop—so much so, indeed, that any opposition to it is beginning to be looked upon as reactionary. At the risk, therefore, of being accused of obstruction we venture to question the advisability or workability of such a law.

In the first place it must be admitted that grade crossings will long be with us. There is no possibility of removing them except in progressive fashion, which will take many years. This is true no matter who pays for the crossing elimination; there simply isn't enough money available from any source to do away with all the grade crossings at once or even soon. In the second place the grade crossing is a fertile source of accident. Statistics of such accidents are too vague to make them worth very much but the mere reading of Monday morning's papers the country over is enough to show that too many people are trying to run an automobile across a track at the same time a train is occupying that particular section of the track.

What are we going to do about this? The crossings cannot be done away with; automobilists will continue to use the roads. It is very simple, say the compulsory stop advocates. Make every automobile come to a full stop before crossing a track, under penalty of the law. But how does this insure safety? Very simple, again. Obviously the driver who stops will take the time to look up and down the track and proceed only when a clear passage is assured.

The theory is open to serious objection. Primarily the law is most difficult to enforce. Most crossings are not policed; certainly the most dangerous ones are not, for that is what makes them dangerous. Enforcement must therefore rest mainly on the danger of occasional arrest through an informer or by traveling policemen, or through the more moral restraint of respect for the law, which latter is well known to be a slender reed when the law is one which the possible offender regards as silly or unduly restrictive. Is a twenty dollar fine a greater deterrent than the danger of imminent death? Who bothers to slow down to 8 miles an hour in those villages where signs dating back to the horseless carriage period still require that decorous progress through the streets? How many drivers, sure of their ability to judge the safety of a crossing, will obey this new law if they think it is more dangerous to stop and then proceed than to keep on across the track with their usual caution?

For there is the chance that the complete stop at the crossing is more dangerous than the cautious continued progress. It sets up an automatic block in a heavily traveled road which, when headways are short, will continue back for a long distance either side of the crossing with consequent dangers of bumping. But worse than that, to start afresh from a dead stop a few yards from a crossing for many automobiles and for many drivers involves possibilities of danger from stalling and slow pick-up which are very considerable.

The cautious driver, then, will if anything be less safe when he stops than when he keeps on going, with due observation of the tracks on either side. How about the reckless driver, who contributes the great majority of the grade crossing accidents? Suppose he does stop and there is no train in sight. He proceeds then in the same safety as though he had continued on his reckless way. Suppose there is a train in sight. Is there any reason to believe that the reckless one will not then take the same chance to beat out the train as he does now in crossing without looking to right or left? Will he be any safer against the unexpected second train which comes along in the other direction after the first one is past? Won't there be just that much more of a thrill in beating the other fellow to it? A fool must be judged according to his folly—and this law doesn't seem to take that into account.

It would not be worth while to express these views were it not that the compulsory stop law is being made a sort of holy cow which every one is urged to kneel down and worship. One's attitude toward safe highways is being gaged by one's acceptance of the necessity of the law. Either you are in favor of making the roads safe and preserving life and limb, in which case you urge the law, or you are in the ranks of the road hogs and speedsters and are against it. This is a ridiculous extreme to have been reached.

There seems to be more than a suspicion that the railroads' partiality to the scheme lies more in the admirable defense in law that it offers to the railroad which has a grade crossing accident than in the expectation that accidents will be lessened by the law. But even if the railroad heads and the safety experts are honest in their advocacy of the law, as doubtless most of them are, the evidence in its favor is not sufficiently clear to make of it the fetich that it may become. Statistics of accidents under and without the stop law are either so inadequate as to be useless as evidence or quite unexistent. Until some statistics are produced to overcome the theoretical disadvantage—or possibly the lack of advantage—of the scheme there seems to be no good reason why any one should favor its extension.

Life of Sewage and Other Sanitary Works

ABANDONMENT of sewage-works after fifteen years use at Marion, Ohio, raises questions as to the life of such works generally. Should an engineer today advise a city that, after fifteen or twenty years a sewage-works is rather sure to be of no further use through a combination of obsolescence, demands for a new site and physical deterioration, each of which played a part at Marion? If so, estimates of the true annual cost of sewage treatment will have to be materially increased. How many engineers will have the courage to tell their city clients so unpleasant a fact? It has long been evident to the well informed that the average life of garbage disposal plants in this country is much shorter than fifteen years. The garbage incinerator built alongside the Marion sewage-works and designed to burn screenings and grit chamber cleanings from the sewage-works seems to have lasted fifteen years but how useful it was when finally closed we do not know. If sewage and garbage disposal works alike are to continue to be so short-lived as experience at many places indicates, the lay officials of our cities ought to know it.

The Marion case is all the more disquieting because the sewage-works there were considered, in 1905, to be unusually complete, combining as they did tanks, contact beds, and sand filters. This completeness seems to have contributed to the early failure of the plant, for it was supposed to produce an effluent dischargeable into a ditch dry or nearly so in summer. With a lesser degree of treatment and an outfall extending to a perennial stream not far away the outcome might have been different That is, conceivably it might have been possible to revamp and enlarge the works at this site instead of building a new plant more distant from the city. But this is only a surmise. The article on the new and old works, elsewhere in this issue, shows that deterioration of both concrete and filter material contributed to the abandonment of the plant. More is known about both today than in 1905 and failures from those causes are lessened accordingly—provided the knowledge is utilized.

A survey of the life of American sewage and garbage plants would be useful. Probably the results would be appalling. Possibly the same would be true of water treatment works. These sanitary works, however, should not be condemned until like information could be obtained for a variety of other public improvements. Short life would certainly be shown for road and street surfacing and perhaps for some other improvements on which depreciation has been commonly figured, when figured at all, for thirty or forty years.

Building a Motor Road Across the Florida Everglades

Conners' Toll Road Through Great Swamp Completes Cross-State Highway for Central Florida—Marl Fill on Marsh Soil Surfaced With Crushed Stone and Oiled

BY FRANK E. LAWRENCE AND R. Y. PATTERSON
Chief Engineer and General Manager, Respectively, W. J. Conners Highway, West Palm Beach, Fla.

A PRIVATE TOLL road is being built through the Everglades and along the shores of Lake Okeechobee to afford a cross-state connection for lower Florida. It is 51 miles long, penetrates virgin country, is surfaced with rock and oiled, and has been entirely financed and built by W. J. Conners, of Buffalo, N. Y., at a cost of nearly $2,000,000. The highway is also of particular interest to engineers in two other respects: (1) It is the first high-grade highway of any length to penetrate the Everglades country, with its soft muck soil and unknown conditions as to foundation and drainage, and (2) the methods used in the construction of the road are unusual and were necessitated by the nature of the country traversed, the inaccessibility of the road, and the problem of materials distribution along its length.

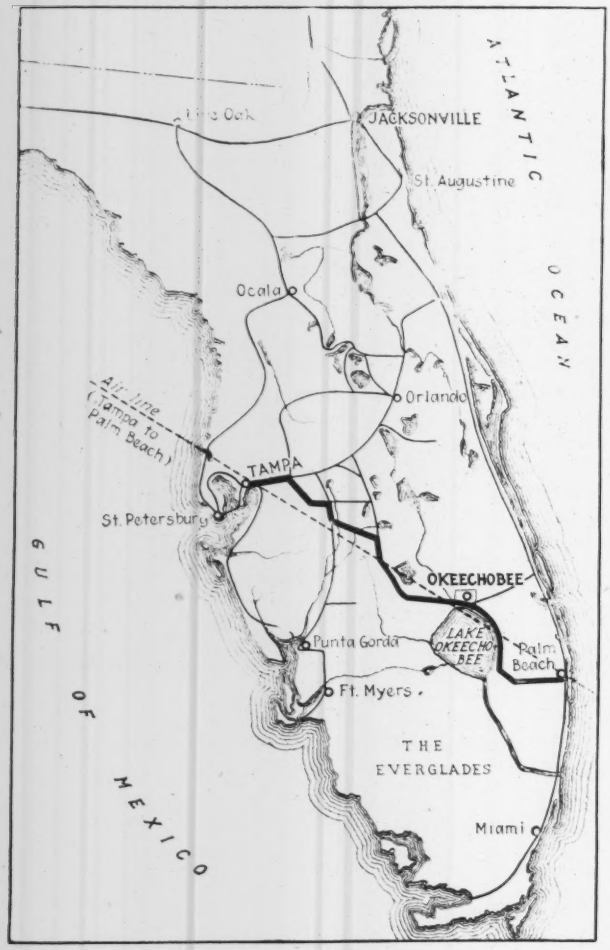


FIG. 1—TOLL ROAD ACROSS FLORIDA EVERGLADES AND CONNECTING HIGHWAYS.

Development of Plan—There has been no highway or railroad across the interior of lower Florida connecting the rapidly expanding east and west coasts. Tampa and Miami are remote from each other simply for lack of a direct connection. The condition is indicated by the route map, Fig. 1. Always the Everglades have been an effective check to all direct communication between coast and coast. Except where drained, they are under water, and the soil is a soft, spongy, vegetable muck not capable of sustaining the weight of heavy structures. However, under this muck surface, and at a depth ranging from 5 ft. to 20 ft., there exists a hard marl, which makes an excellent roadbed or foundation.

A few years ago W. J. Conners, who had acquired very large tracts of land along the shores of Lake Okeechobee and in the Everglades, conceived the idea of a cross-state highway that would penetrate the Everglades, open up his land, follow the shore of the lake and strike across toward Tampa. He obtained from the state a franchise to build a toll road from a point 23 miles west of West Palm Beach to Okeechobee. Beyond that town there remained an uncompleted stretch of 30 miles of State Road No. 8 to reach Sebring, from which point excellent roads were already in existence all the way to Tampa. Contracts have been let by the state covering the thirty miles, of which the Conners organization is building the Kissimmee River bridge which has a length of 3,200 ft. By December all links will have been completed.

The task was to provide a heavy duty, modern highway, in the shortest time possible, through virgin country, inaccessible to material and supplies, and on a roadbed that would be practically all an embankment of sand or muck, resting in many places on a muck base of undetermined stability. No such heavy traffic road had yet been built through the Everglades, and the problem of supporting the load had to be solved. Again the road borders closely the eastern shore of Lake Okeechobee, and the problem of unstable foundation had added to it the effect of periodical high water, and of storm action on the roadbed.

On the lake section the roadbed is almost entirely in the soft borders of the lake, and when the grading was done it was largely under water, as the lake level was unusually high at that time. The material is in some places sand, in others muck, and in still others a mixture of sand and muck. Allowance had to be made for a certain amount of settlement. Protection is had from the direct action of storms by vegetation in most places, but there are a number of points where a revetment is necessary to prevent the bank from washing away. On the canal section, which is through the Everglades, the marl that underlies the muck provided a roadbed material of the best character. By deepening the canal and depositing the material on the bank, Fig. 2, with sufficient berm between canal and roadway, and then spreading it sufficiently, a mat is formed on the muck that is amply able to carry the loads to which the road will be subjected.

In view of the expected settlement of the roadbed it

was decided to surface it with one layer of crusher-run rock, making it sufficiently thick to form a well-bonded crust. An average of 12 in. of loose rock was spread on the lake section, 8 in. on the soft marl and 5 in. on the rock base, of the canal section. An application of ½ gal. of oil per square yard was put on, which will be followed by another coat in six months. This provides a sufficient thickness of surface, well protected, during the time that the roadbed is taking its final settlement, and expensive material will not have been wasted, as would be the case if a finished surface were constructed at first. It is contemplated that after the lapse of two or three years of settlement, under careful maintenance, with weak spots developed and brought up, an additional layer of rock will be applied and fully penetrated. The width of the paving is 16 ft. and the minimum width of road section is 24 ft. which gives a 4-ft. shoulder on each side of the paving.

There are 28 timber bridges, ranging in length from 20 to 525 ft. All are built to a standard pile trestle design, with a clear width between handrails of 18 ft. 8 in. The piling and timber were all from the owner's lands and the lumber was cut in a field sawmill, especially built and equipped for this job. In addition to the 28 timber bridges, there are four bridges involving drawspans over canals and rivers. That at St. Lucie is a temporary trestle, and is to be replaced with a handsome reinforced-concrete arch bridge with a center drawspan. The other three are bridges supplied by the counties and are steel spans.

Crusher Plant—About the most important consideration in figuring on this road was the source of supply of paving rock. The only quarries in the lower part of Florida were located out of reach, and it was necessary to develop a supply that would be nearer at hand. The St. Lucie Canal had been dredged a couple of years previously from the lake to the St. Lucie River, and where the canal left the lake an excellent grade of lime rock had been cut through. For 1½ miles on both banks of the canal there was a good-size spoil bank of rock which when properly cleaned and crushed makes a fine road material. The spoil banks were not of sufficient extent to supply the job, but plenty of undug rock still lay in the bottom of the canal.

Here was the natural location for a crusher plant, and one was designed that would handle 1,500 cu.yd. in twelve hours, and a washing plant was installed to eliminate the dirt and sand that were dug with the rock. A grizzly at the main crusher passed much of the fine material directly to the buckets leading to the screens.

To make up the spoil bank deficiency when the south bank had been dug out, a 2½-cu.yd. dipper dredge threw additional material on the bank. This dredge had a capacity of 2,000 cu.yd. in 24 hours, and supplied about 100,000 cu.yd. of material. In the pits two oil-burning revolving shovels on crawler tread loaded the cars for the crusher. A traveling crane was also used as an auxiliary in connection with cleaning up banks, so both the shovels could be constantly employed on their own work. Three miles of track were built around the crusher and connected it with the pits. In all 26 4-cu.yd. dump cars, and two, at times three, 8-ton gasoline locomotives were used between the pits and the crusher.

FIG. 2—MARSH FOUNDATION THROWN UP FROM CANAL BOTTOM BY DREDGE

A car of material ready for the crusher was at all times at the bottom of the incline, and the incline had a capacity of one car every two minutes.

The plant was designed to use two crushers, one of which took the screen refusal. Both crushers were of the gyratory type, the main one being a 20-in. and the secondary a No. 3-D. The power for the plant was furnished by a semi-Diesel engine of 200 hp. The plant readily handled 1,000 cu.yd. during a 10- to 12-hour day.

The pit material was brought into the plant up the incline, the cars being hauled up with a cable on a single drum hoist. The cars were dumped over the grizzly into the main crusher which fed a bucket conveyor leading to the screens. A 6-in. pipe through the axis of the main screen and perforated every few inches supplied water as needed to wash the material as it passed through the screen.

From the screens the waste material mixed with the water ran off through chutes to the dump and the washed rock passed into the bottom-dump bins, one of which was for the graded top rock, and one for the crusher run. As the graded top rock was not used in that condition the crusher run rock was diverted into both bins. The bins were elevated to allow trains to run under them to get their load. The rock could also be diverted directly to stock piles outside the bins. This area could store 3,000 cu.yd. and was located between the crusher bins and the barge bins on the canal bank. A large stiff-leg derrick also located outside the plant loaded from the stock pile to the 300-cu.yd. barge bins. Barges

were loaded by placing them alongside and chuting through side-opening doors.

Fig. 3 shows the layout of the crusher plant. It shows also the location of shops for repairs. There was a well equipped machine and blacksmith shop that assisted in building the fleet of barges as well as the plant, and later took care of all running repairs. Cars and locomotives were rebuilt and all rolling equipment inspected and attended to on each trip back to the plant from the front.

The crushing plant and shops were operated separately from the two construction divisions, and were in charge of a plant superintendent. The location was 21 miles from the Okeechobee end and 29 miles from the Palm Beach end of the job, and 9 miles from Canal Point where Division 1 ended and Division 2 began. The plant did much of its work at night, and plant, pits, bins, etc., were all illuminated for night work. The maximum week's work was 8,085 cu.yd. or an average of 1,350 cu.yd. per day. At the end of the job the plant is in as good condition, barring some running repairs, as when it was placed in service, and it will probably

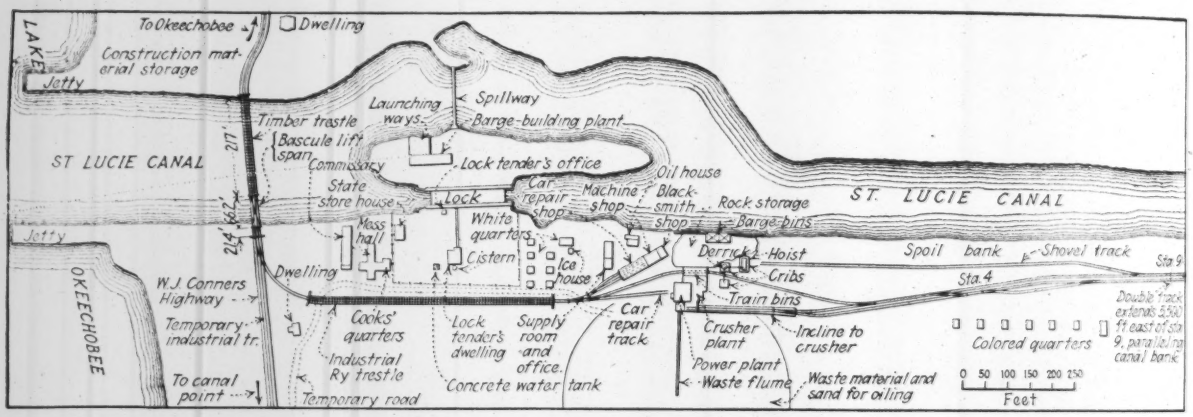


FIG. 3—CRUSHER PLANT AND HEADQUARTERS CAMP LAYOUT

be utilized to supply the adjacent country with concrete and road rock.

Canal Division Construction—The canal division or Division 1 parallels the Palm Beach Canal, and is located along the south bank. It begins at what is called Twenty Mile Bend, where there is being developed a new town called Westport. It is 23 miles west from Palm Beach on an existing hard surface road. Its west terminus is Canal Point on Lake Okeechobee. The division is 19.4 miles long.

On this division the road is entirely within the Everglades. The natural surface is a soft spongy mass that will not support any load of consequence, and it was here that the most uncertainty prevailed. A contract was made between Mr. Conners and the state to dredge the canal at joint expense, depositing the marl on the south bank (Fig. 2) to be used for the roadbed. The muck surface is about 10 ft. deep. A berm 25 ft. wide was left between the canal and the edge of the road grade to keep the muck from slipping into the canal, and it was also necessary in many places to provide additional support by bulkheading with piles. In some places, also, large rock that had been dredged was used to riprap the bank.

For nine miles east of Canal Point the material dredged was rather soft marl, which when dried makes an excellent base. It is necessary to keep water away from it, however. The remainder of the canal section contained a marl rock that made a fine base. The average elevation of the canal bank is 16.5 ft. above sea level, the top width of the fill completed is 24 to 33 ft. and the average height of completed roadway is 4 ft.

As the material was deposited on the bank by the dredges, three in number working on different sections, it would sink into the muck and in many places would go entirely through to the marl bed. It was a matter of filling until stability had been established.

Following the work of the dredges, and after the material had dried and hardened sufficiently to be got into, a small revolving shovel, Fig. 4, was employed. This traveled on mats and spread the bank to the desired height and width. It worked two shifts of ten hours each, and it made an average of about 800 ft. per day. It graded a wide, comparatively level roadway, finished on schedule time, and was a success in every particular, quite in contrast with the labor gangs that were at first employed on this work.

The shovel left the roadbed ready for fine grading, and this was done with a five-ton tractor and grader. This unit smoothed the surface, graded to the desired lines and cut the 16-ft. section ready for rock. The material shaved from the inside was piled up just outside the sideboards for shoulders and after the paving material had been laid the shoulders were cut down by this same grading unit. A five-ton tandem roller completed the operation of fine grading by compacting the base until it was as firm as the finished top.

The entire top course of paving material used on the Canal Division was brought from the crusher on barges. The maximum haul was 29 miles, and the average 19 miles. For this service there was employed a fleet of nine rock barges and four boats for towing. Two boats were used in the canal, one between Canal Point and the plant, and one shifting barges at the plant. This was organized under a department of water transportation, and placed under a superintendent, whose duty it was to have loaded barges at the job at all times. Barges were loaded and transported twenty-four hours of the day during the height of the construction period, and as the crane could unload six barges per day under favorable conditions it was a problem to keep that outfit busy.

The soft material on the canal would not support the weight of equipment needed for unloading, so a special

pile platform was built every two miles along the canal bank for the 32-ton crane, Fig. 5, used for transferring material from barges to trucks. The platforms were designed to take care of the heavy work of the crane movements and were 20x20 ft. They were left in place, and are being used for maintenance and general work.

By locating the platforms every two miles the maximum haul for trucks was only one mile. A fleet of ten Ford trucks was used, about seven of which were in constant service. The crane loaded the trucks through a simple hopper, the only function of which was to concentrate the flow of material from the bucket to the truck. Paving was usually carried on in both directions from the loading point, as one turn of the trucks was eliminated each trip by continuing through the hopper and on to the other dump. As dumped the material was spread and later shaped up with a grader and followed by the rough rolling. No finishing was attempted until near the end of the job, when a complete outfit could start in at one end and go through to the other without interference, and be followed as closely as possible by the oiling.

A floating camp was provided for this organization. Houseboats were used for the men and barges for repair shop, supplies, etc. A complete Ford repair shop was set up with an expert mechanic in charge, and the trucks were kept running in very satisfactory manner. The crane could be loaded onto a barge, and the entire outfit moved to another station in a half day.

The first barge load of rock was delivered to the canal on Dec. 27 and the last on July 1, during which time a total of 31,000 cu.yd. of crusher rock went into the completed road.

Lake Division Construction (Division No. 2)—The Lake Division begins at Canal Point, where Division 1 terminated, and parallels Lake Okeechobee to Okeechobee. The distance is 31 miles. A high ridge of fine sand extends along the shore the entire length and is covered with a luxuriant growth of palms and semi-tropical trees and plants, Fig. 6. This could not be used for the road except in a few places, as it is reserved for residences. This threw the road on the lake side of the ridge and resulted in much more difficult construction, but the final outcome will be a more satisfactory and valuable frontage.

The roadway is almost entirely in fill which averages 4 ft. in height and 24 ft. in width on top. It was thrown up with dragline excavators, five of which were employed on the work. From Canal Point to Chancey Bay, a distance of 17 miles, much of the soil is muck, and here it was that the greatest difficulty was experienced in getting a final settled grade for the paving. It was a fight from start to finish, and the settlement will not be complete for two or three years, but the

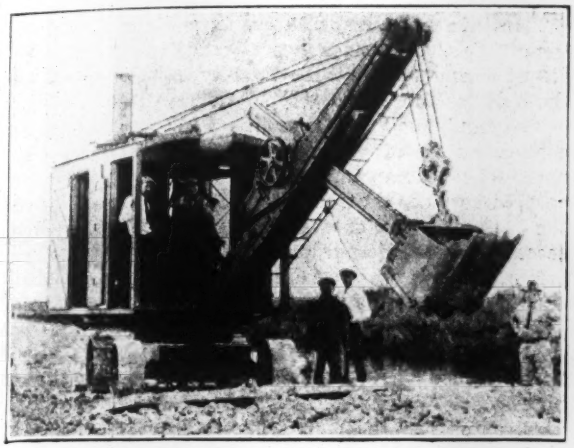


FIG. 4—LIGHT STEAM SHOVEL LEVELING DREDGE FILL ALONG CONNERS HIGHWAY

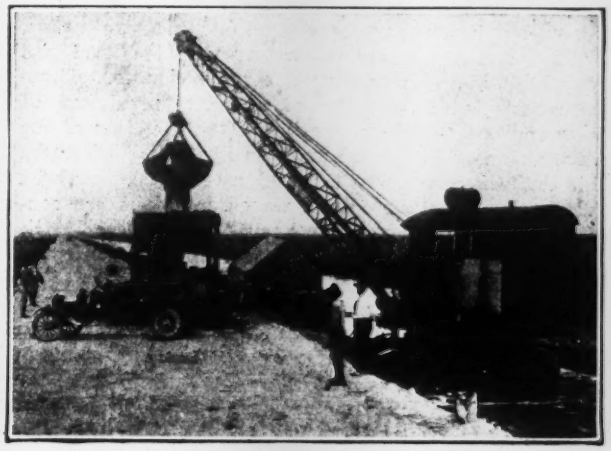


FIG. 5—CRANE LOADING SURFACING TRUCKS WITH CRUSHED STONE FROM BARGES

FIG. 6—TRACK RAISED ON FIRST LAYER OF STONE SURFACING

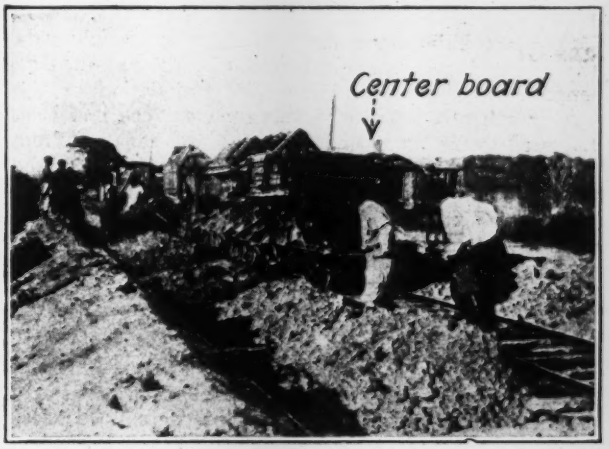


FIG. 7—CENTER BOARD IN CARS THROWS HALF LOAD EACH WAY

roadbed is now sufficiently stable to permit of a good road, though somewhat rough. North of Chancey Bay the foundation is sand, which afforded an excellent base.

In the muck sections it was found that sand is the best cushion to use, as it penetrates the muck and makes a mixture that has some body. Crushed rock applied directly to the muck is useless, and a waste of material. In spongy muck there should be applied at least a foot of sand before any attempt is made to surface. Then when the rock is applied a double thickness should be used. With these precautions a good road can be obtained, but it must necessarily be an expensive means.

When the grade was thrown up the lake level was very high and storms caused some washouts. These were remedied by the use of a simple revetment of poles and boards driven slanting in the direction of the wave action. The lake abounds in hyacinth, and where this can be confined near the bank a very effective check is offered that will break all waves. A light pen construction of piling wire or boards that will hold the hyacinth is elastic, and better than anything except a rock riprap slope.

A 36-in.-gage industrial railway was used for the delivery of rock from the crusher to all points on this division. Twenty miles of railway were laid connecting the plant at St. Lucie with Taylor's Creek, near the north end. Thirty-pound steel was used, and pine ties were cut from the timber lands of Mr. Conners, loaded onto barges at Okeechobee and barged to various points along the line, where they were unloaded and hauled by rail to the end of track. Three construction docks were built along the lake shore at which were located camps; here also materials for the railway and supplies were handled. Upon the completion of the track north of St. Lucie and as soon as rock had been delivered to the north end the track was removed from that end toward St. Lucie, the rail was sent over the railway south of St. Lucie and the ties partially hauled by rail and partially to the nearest dock where they were loaded into barges and sent around by water. In this way the track south of St. Lucie was laid as soon as it was removed from the north end.

It was decided to lay the track in the center of the grade in spite of certain difficulties, as it would have been impossible to complete the work by placing the track on the side. The width of fills and nature of material made this impracticable. Placing the track in the center made it necessary to devise a method of equal dumping on each side, and this was accomplished by inserting a center board, Fig. 7, along the center line of the car bodies, and raised 6 in. above the sides. When the car was dumped on either side by knocking down the chains the car would dump to one side and the center of gravity would then shift, pulling the car over to dump on the other side. This worked very successfully.

In order to get the full quantities dumped it was necessary to raise the track and redump. This track raising came in especially well, as it gave a ballasted track to run over, and with a soft subgrade this was also necessary to get trains over the line. The rock was dumped from the crusher out and the track raised immediately behind, both to clear the sides and to give stable track. The second dumping was done on the way back to the crusher after the first dumping had reached the end of the line at Taylor's Creek.

The material was spread after the first dumping and also after the last by means of a special spreader devised for this job by the superintendent in charge of this division. Two car trucks were converted into a special car with a frame built about 6 ft. high and filled with sand. On this was hung a double set of folding wings made of sheet metal and timber that could be adjusted to any angle in two planes. A V-shaped frame under the car cleared the rails of material that was dragged into the track and left it flush with the rails ready for raising. The car was pulled with an 8-ton gas locomotive. All material between the side boards was in this manner spread evenly and uniformly. For some time the spreader was attached to the front of a steam locomotive, but the final type was found to be the best for the work.

The equipment used on this haul was two 14-ton saddleback steam dinkies, four 8-ton gas locomotives and 44 1-yd. dump cars. There was a total of 66 such cars in service, the remaining 26 being used between the pits and the crusher. The steam engines were secondhand and did not give satisfactory service on rock trains. They were accordingly put in worktrain service and the rock was hauled entirely with the gas locomotive. Inasmuch as the haul was greater than for the usual road job, and as the locomotives were in service 24 hours a day, they gave remarkable results. It was necessary, of course, to have a very well organized shop service to keep them running, and it was so planned that there were three trains on the road and one locomotive going through the shops at all times. On each trip back to the crusher, the locomotives, as well as cars, were inspected, gassed, oiled and minor repairs made, and the telephone service used in connection with dispatching trains was resorted to to notify the shops of anything needed so that everything would be in readiness to make repair as soon as the train returned to the crusher.

The cars were actually loaded with 5 cu.yd. of material and eight cars made up a train. The grades were nearly level, but there was an overload at all times. The locomotives finished the job and were ready for further service when the last car went out.

A telephone line was constructed along the two divisions when the track was laid and a carefully laid out dispatching system was installed when trains began to move over the line. Sidetracks were installed every two miles and opposite each switch a plug was installed. A portable telephone was carried on each locomotive, with wire connections so that a train could communicate with the dispatcher at any point on the line. Between sidetracks connection was made direct with the linewire. The dispatcher's office was located at the division headquarters, and throughout the long runs a day and a night shift of trains and dispatchers were used. All trains ran under orders, work trains as well as rock trains, and the dispatcher kept a daily sheet that recorded all delays and running time of all trains. In case of trouble on the line the train called up the dispatcher who notified the shop or got in touch with gangs on the line. As soon as the shop was notified of a wreck and had the information as to what was wanted, repair men were sent to the scene at once on a track motor car with the parts needed. In this way the job headquarters at Okeechobee was in constant touch with all parts of the job at all hours of the day and night.

Fine grading was done by hand ahead of dumping and

1-in. guide boards set the entire length of the division. These were not removed until the final finishing operation.

As soon as the trains had reached the far end with their dumping they began to dump back toward the crusher. Two-thirds of the needed quantity of rock was dumped on the way out and the other third on the way back. The track spreader followed closely behind the back dumping, and wherever it was found that the quantities were shy additional rock was at once hauled in.

Behind the spreader came the track removal gang that took up rail and sent it by work train to the other end or to the storage yard. The ties were then removed and the next unit followed, consisting of a 5-ton tractor and a No. 8 grader. This unit spread the rock and trimmed it up ready for rough rolling. Behind this came two 10-ton three-wheel rollers doing the rough rolling, and following them were two more heavy rollers, grader, water wagons and finishing outfit. A light 5-ton tandem roller accompanied this phase of the work to finish stretches that could not be completed with the heavy rollers, and for several miles through the muck north of St. Lucie it was found necessary to roll the rock and get a waterbound surface, then relay the track and repeat the dumping process to get a double amount of rock into the road. After this second treatment the surface stayed where it belonged, but even so it is settling and will require a refinishing after some months.

For the oiling of the road a pressure distributor, mounted on a 5-ton truck, was purchased, but it was found expedient to contract the oiling, as the haul was long, and required much equipment in the way of trailer tanks. The road from Okeechobee to St. Lucie, with a maximum haul of 25 miles, was oiled from Okeechobee. From St. Lucie south the oiling was done from West Palm Beach, the maximum haul in this case being 51 miles. With eight to ten tanks in use it was possible to get 1 to 1½ miles per day with one trip out and back.

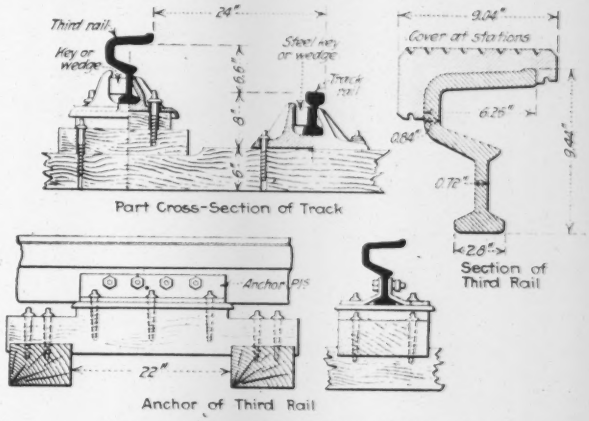
The first rock went into Division 2 on Oct. 16, 1923, and the last car was dumped on June 23, 1924. A total of 96,000 cu.yd. was hauled out and finished in this time. Work was begun on the highway in April, 1923, but was not actually under way until June, when work was started on the erection of the crusher plant and grading was started. On June 25, 1924, the road was opened to traffic and toll charges started. On July 4, 1924, the road was officially opened with a celebration at Okeechobee. During the year that had elapsed a total of nearly 130,000 cu.yd. of rock had been dug and dredged from the canal, passed through the crusher plant and transported an average distance of 11 miles by industrial railway and barges, and the road finished ready for use.

The first thing that was done when the present organization went in was to lay off progress charts and time schedules, and the execution of the job was built up around these.

The general supervision of the work was in charge of R. Y. Patterson, general manager; F. E. Lawrence, chief engineer; and Daniel Downey, general superintendent. The field operations were in charge of D. H. James, superintendent of the crusher plant and shops; A. A. Sturgis, superintendent of Division 1; J. C. Johnson, superintendent of Division 2; E. A. Forbes, superintendent of water transportation, and Jack Barrett, division engineer.

Third-Rail for Electric Track in Paris

IN THE electrification of the suburban lines of the State Railways at Paris, France, a third-rail conductor of new and curious section is being used, as shown in the accompanying drawing. This rail is designed to give an under-running contact surface and to be self-protecting against trouble from sleet. It weighs about 76 lb. per yard and is carried in cast-iron chairs, each attached to two superimposed blocks of wood treated with paraffine and placed on the ends of long ties spaced 14.76 ft. apart. By this use of two blocks the four



TRACK FOR PARIS ELECTRIC LINES

screw spikes which hold the rail supports do not enter the tie. These electric lines are operated by 650-volt current.

The third rail is made in lengths of 60 ft., but the joints are welded in the track to form continuous sections about 820 ft. long. These sections are connected by expansion joints having plates riveted to the horizontal member of one rail and secured to the adjacent rail by bolts in slotted holes. Each 820-ft. section of rail is anchored at mid-length by bars bolted to the web and fastened by screw spikes to a wood block resting on two ties. At points where station employees may have to cross the tracks, the third rail has a safety covering of basalt blocks with checkered top surface, as shown; these blocks require no fastenings but are held in place by their own weight.

The track rails are of the bull-head section, in 72-ft. lengths.

This electrification is described in the *Revue Generale des Chemis de Fer* by M. C. Thomas, electrical engineer of the State Railways.

Oregon Campaigns Against Forest Fires

Initiated by the Klamath Chamber of Commerce, a state-wide campaign was carried on in Oregon, June 30 to July 14, to form a "Stop Forest Fires" Association, members of which pledged themselved to do all in their power to prevent forest fires. Members received a card with rules for fire prevention printed in full, a windshield skicker and booklets of directions for camping in forests. Newspapers and civic organizations aided in the campaign. While results can not be checked exactly, it is significant that in a season of great hazard from drought there was no undue loss of timber from forest fires. A similar campaign was carried on in the state of Washington, sponsored by the Seattle Chamber of Commerce.

Notes from Foreign Fields

Germany's Revival

Hope and Financial Soundness Have Replaced Despair and Inflation

By E. J. Mehren
Vice-President, McGraw-Hill Co., Inc.

NO COUNTRY in the world today is, from the economic viewpoint, so interesting as Germany. She occupies the spotlight in Europe. What is to be her future?—is the question that everyone in the old world is asking.

The answer to that question no one can tell. The problem is complicated. But this even the casual visitor to Germany can say: *Germany has made tremendous strides since the war; she is showing extraordinary recuperative power, against tremendous handicaps; she has worked a financial miracle since November of last year; and, finally, no nation that shows Germany's potential strength can be permanently kept down, can be crushed.*

These observations, let me repeat, even the casual visitor must make. The signs are written everywhere: in a people again well nourished, in a public administrative ability (irrespective of party) that was able without new revolution to stabilize the currency, in a returning hope that Germany can again rise. There is not buoyancy of spirit, but there is a deep-founded confidence that the nation is not going to pieces.

The situation is in sharp contrast to what one expects. In America we hear of the wrecking of the currency, of the sufferings of last winter, of the difficulties under which her industries labor in securing raw materials and finding markets. Upon these reports—which, of course, are correct—we paint with our imaginations a country on the verge of despair, a disrupted industry, a tottering government. The surprise is a great one—and, if one is fair-minded, he must come away with deep admiration for what has been accomplished.

Germany's Handicap—Let us briefly paint the picture of Germany's economic circumstances:

Under the Versailles treaty or as a result of it she lost heavily of her iron and coal deposits—in Alsace-Lorraine, the Saar and Upper Silesia; she lost her colonies, her foreign investments, her shipping, her export organization and its connections; she sees a large part of her territory under the control of her former enemies. In addition she has been through an exhausting war and a political revolution.

These conditions are not new; they existed when I was in Germany just four years ago, in the summer of 1920. The result was what might have been expected—an under-fed, discontented people, a disorganized industry and an all-pervading discouragement, unrelieved by any ray of hope.

Since then, since 1920, two other financial disasters have forced themselves into the picture—the occupation of the great industrial district of the Ruhr, and the wrecking of the currency.

With these added calamities one should logically expect that conditions would be worse instead of better, that the despair would be even blacker than before.

And yet conditions are as I have described—immeasurably better. Here is a nation on the upgrade, rather than the down. Here is a nation to be reckoned with economically, not to be ignored; here is a nation that is sure to be an important factor in the world's industry.

This last is a bold statement. I realize what terrific handicaps the rest of the world *can* put upon Germany if it wishes. It *can* keep Germany impotent, but it is my belief that it will *not* do so. Sentiment, moreover, will play no part; commercial considerations alone will lead to trading with Germany. Other nations will want to sell to the markets of a reviving Germany. If they sell to Germany, they will buy from Germany, and if they buy from Germany a prominent place in world affairs is assured her by the potential strength she is now so conspicuously displaying.

Many Difficulties Ahead—Let it be clearly understood that the path of recovery for Germany is not an easy or a quick one. She is not out of difficulty. The economic handicaps recited above are still upon her; some of them are being slowly removed, such as the absence of shipping and foreign commercial connections; some of them, such as the lack of colonies, may never be removed. But a nation that under present handicaps has recovered as she has done will rise despite the obstacles that a commercially-minded world is likely permanently to place upon her.

The Turning Point—The great German economic miracle was wrought in the closing months of 1923 and the early part of 1924. Early last autumn Germany truly—to use the words of Basil Miles, administrative commissioner for the United States in the International Chamber of Commerce—was at the cross-roads. Directly ahead on the road she was traveling—the road of unbalanced budgets, of state subsidy of the railroads, of currency debasement—was revolution, industrial suicide, destruction. To the right was a stormy path, extremely difficult, beset possibly by disorder, possibly by revolution, but leading, if the difficulties could be mastered, to economic soundness. It was the road of a stabilized currency, with its accompaniments of balanced budgets and governmental economy. Germany chose to go to the right, to take the difficult road, to bear the stress of financial reform and currency stabilization. She did it at a time, too, when the situation in the Ruhr was at its most critical stage, when strong forces were seeking to pry loose the Rhineland and erect it into an independent state, when the attitude of Bavaria toward the rest of Germany was much in doubt. But she went on nevertheless. The government declared that the mark should be stabilized at four trillion 200 billion to the dollar. There was a severe contest with the mark speculators, but by severe measures the government won, and since November, 1923, legally, and about January 1, actually, the rentenmark has stood at 23.8 cents to the dollar. There was no revolution.

That achievement marked the turn. It showed the return of administrative strength in the German government. It restored business to a sound basis. It killed speculation and the orgy of spending. It restored the incentive to save and therefore to work. It marked the end of the crisis in the economic and social disease and the beginning of recovery.

Germany *is* beyond the cross-roads and has chosen rightly. The future is long and difficult, but there is

health where there was disease, there is hope where there was despair.

Some Details Briefly Told—Let me now add some details—briefly. They will help to an understanding of the situation. Each item deserves elaboration, but that would take much space.

The severest present industrial handicap is lack of credit. The great credit reservoirs were nearly or entirely wiped out by the fall of the mark. Further, there was no incentive to save; industries and individuals converted the tobogganing mark into goods as quickly as possible. Today the credit resources of the banks are estimated at one-tenth the pre-war amount. When credits are obtained the interest rate is 2½ per cent per month for the very best security.

There is a terrific money shortage, which also curtails business, for which lack of credit everyone tries to insist on cash on delivery.

Wages are at approximately pre-war level. Prices, as of July 15 (according to the *Frankfurter Zeitung* index, which is the highest index I could find and takes in 98 commodities) are 34 per cent above 1913. (The government's index for wholesale prices is 12 per cent above 1913.)

Efficiency of labor has increased notably and is still increasing. *I heard no general complaint against the workingman in Germany as I did in England.*

Unemployment, while fairly large just now, is not as great as that of Great Britain, and does not present the all-engrossing problem in Germany that it does in the British Isles.

The works councils, elected by the workers, are said by the employers to be a good influence. They help smooth out difficulties and, in general, have not been radical.

Hours of work per day are increasing.

The coal supply, which by its shortage was expected to be for many years a serious handicap to German industry, is now more than ample on account of the very large development of lignite deposits.

The heavy taxes imposed on industry and individuals are beginning, under the stabilized rentenmark, to yield a good revenue. Recent figures show a surplus that has been used to retire obligations.

There is much more to be said and the details just given need elaboration. But these few particulars will help to fill out the picture as I saw it—the picture of an industrial nation again on a sound basis, well organized, confident that somehow it will work out its difficulties and play a part in the world of industry and commerce.

Berlin, July 30, 1924.

What the Dawes Plan Means to the World

In connection with Mr. Mehren's observations in Germany the following succinct résumé of the Dawes Plan and its effect on the business of the world is taken from the September Letter of the National City Bank of New York.—EDITOR.

IT WOULD BE too much to say that provision has been made against all possible disagreements, and that everybody is going to be satisfied with the results of the Dawes Plan. The plan is largely experimental, a scheme for an undertaking the like of which never was attempted before, but it has been before the world for more than four months, and nobody has been able to find any serious fault with it. The most common criticism of the plan has been on account of its not determining how long the payments should continue or what the aggregate should be. Under the Versailles treaty the determination of the sum was placed with the Reparations Commission, but the agreement of 1921 fixed the sum at 132,000,000,000 gold marks. This sum appears to stand, subject to action by the Reparations Commission. The amortization arrangement upon the railway and industrial bonds will extinguish them in 37 years, and the bond payments constitute about 40 per cent of what the Dawes Plan calls the "standard" annual payment. Evidently further action will be necessary to determine the total amount.

The Great Experiment—The plan is a great experiment. There is no precedent for the payment of sums of this magnitude where the payments run one way and no offsets are available. These payments are outside of trade, which has a natural tendency to settle itself. Over and above its regular foreign trade settlements, Germany must export goods or services to cover the obligations of this agreement.

There is great disagreement among people who have standing as experts about Germany's ability to make the payments, and about the probable effects of such payments, if they are made, upon the industries and trade of other countries. Considering first the ability of Germany to pay, it is evident that this will depend upon high production by the German industries coupled with low consumption by the German people, thus enabling a great industrial product to be exported. Following the analysis further, it probably means long hours in the industries, or at least the working day which will yield the largest product. Invention and improved methods are the best way of increasing production, but their results are incalculable, and anyway take time. Moreover, they require capital accumulations, which will be difficult to make in Germany. But besides increasing production it will be necessary to reduce consumption, or at least prevent consumption from increasing to correspond with production, for it is a surplus of production and of exports that is required. In order to hold down consumption it will be necessary that wages shall be low as compared with the cost of living, which may be accomplished either by means of low money-wages or by taxation which raises the prices of everything the people have to buy. Taxation is the method by which the government takes over the share of production which must go for reparations.

Briefly stated, these are the conditions which must be imposed in order to create a large surplus of exports over imports. Economists describe them very simply, but can they be put into effect as easily as they are described? The German government promises to do it, but if the 10-hr. day is necessary, can the government compel the workmen to accept it, and if lower wages or a lower standard of living are required in Germany than in neighboring countries, will the masses of the German people accept them and work as cheerfully and efficiently as in the past? These are crucial questions.

Effect Upon World Trade—In case Germany demonstrates her ability to create a surplus of exports over imports sufficient to meet the reparation payments, what will be the attitude of other countries toward such a volume of German exports and what the effect upon business elsewhere? Economists whose opinions are entitled to respect are able to dispose of the difficulties which some people apprehend, as easily as they show how Germany can create her surplus of exports. Arranged by them on paper there does not seem to be any problem. And yet in the countries adjoining Germany, particularly among business men producing the same kind of commodities which must constitute the chief exports of Germany, no little concern is manifested. Evidently the British industries are apprehensive of severe competition, for the British Prime Minister has announced that he will appoint advisory committees representing the principal industries, to confer with the government.

The reason for this apprehension is that the principal industries of Germany are of the same character as the

principal industries of Great Britain, and this is true of other countries as well. Germany's increased exports must be of products like the products of other countries. How many such products can the markets take? It is an economic truism that there is no possibility of over-production, provided production is well-balanced. It is all a matter of balanced demands and offsetting exchanges. If it were possible to increase all kinds of production simultaneously, the aggregate might be doubled, provided all kinds came on the market in the right proportions, and there would be no disorder; the world would simply move up to a higher standard of living. If this is what Germany's increased exports will mean, there is nothing to fear from them; but will the supply of all kinds of goods and services increase in the right proportions and be absorbed without disturbances? This is what business men are not sure about.

On the other hand, it is true that the credits created around the world by the surplus of German exports will be turned over to the allied countries, constituting the reparation payments. They will constitute purchasing power to be used by the allied countries instead of by the German people. Why then should there be any more disturbance than if there were no reparation payments?

The whole question turns upon the degree of abnormality in the situation. It is the abnormal developments that disturb the industrial balance. Are the offerings of the principal German industries—iron, steel, machinery and the textiles—going to be greatly in excess of their offerings in the past, and if so what will be the effect upon those particular industries in other countries, and what will other countries do about it? Also, what will the purchasing power created by these reparations payments be used for, and to what extent will such purchases provide employment for workmen who might be thrown out of employment in other industries? Workmen do not change employments readily, but prosperity in one industry tends to make employment in other industries.

Germany Short of Capital—It is also to be considered in this connection that Germany may require considerable time to get into full productivity. While her industries are understood to be generally equipped for a larger production than ever before, the country is financially weak. There is a great shortage of working capital, as prevailing interest rates show. This is the result of having practically wiped out bank deposits and the entire creditor class by the depreciation of the currency. The saving class has been exploited and saving discouraged. The country must start in again to encourage saving and build up a new savings fund. The industries cannot run full without more working capital than the country possesses. It will take a long time to accumulate what is required, and immediate relief must come by attracting foreign capital with high rates of interest and by inducements to invest in the industries. But as an offset to any inducements that can be offered there will be the high taxes to pay reparations, and the danger of labor troubles and socialistic agitation arising from the conditions heretofore mentioned. German industry will have a hard time conquering the world on 25 per cent interest, and German socialism will have a fine chance to study the law of supply and demand in relation to capital and the interest rate. Here again there arises the question as to what public opinion will do. We know enough about politics in this country to expect a holy crusade against high interest rates. If Germany had not just received a very costly course of instruction upon the difference between paper money and capital, we might expect proposals to start up the printing presses, but the Germans probably are immune to that heresy for the present. Will it be possible, however, to maintain returns upon capital in Germany at least high enough to attract outside capital, simultaneously with low wages and high living costs? Is it possible either to suspend the economic law in Germany or to make everybody understand it?

Position of the United States—So far as the United States is concerned, it seems probable that the revival of Germany will have a direct effect in increasing that country's demands upon us for such raw materials as cotton and copper and probably for meats. Unquestionably competition will be sharper in the lines of manufacturing in which Germany is proficient, and the effect of sharp competition in world markets will be to lower industrial costs and prices.

In one of the lines in which Germany is proficient, however, the manufacture of electrical equipment, the world demand is likely to be large enough to keep the capacity of all countries fully employed for years to come.

In the long run, however, and when the readjustments required to restore the world's equilibrium have been made, the recovery of Germany unquestionably will be generally beneficial. Whatever disturbance there may be will result from the fact that new and strange conditions are created, and that readjustments are necessary. The tendency always is back to normal.

Conference on Inter-Allied Debts—Naturally, France is much concerned about the inter-allied debts, and another conference upon this subject will be held in the near future. It is probable, however, that some time will elapse before much is done on that line. All of the obscurities of the reparations question hang around the inter-allied debts as well, and since some of them are likely to be cleared up as progress is made with reparations, why not allow the situation to drift? Few countries have begun payments upon the debts, and none of the creditor countries are pressing. As to the payments that are made in the interim, at most they will be a small factor in the whole problem, and probably nobody contemplates sweeping cancellations.

Gravity Material Supply Cuts Handling Costs

One-Yard Mixing Plant Delivers 400 Cu. Yd. in a 10-hr. Day—Unique Equipment for Distributing Concrete

OBTAINING GRAVITY feed to a concrete mixing plant located, of necessity, in a restricted place requiring a special layout is an interesting feature of the track elevation work on the Pennsylvania R.R. at Cleveland, Ohio. The mixing plant, near 75th St. and Platt Ave., is almost under the main line tracks and yet eight men deliver the sand and stone, receive, store and feed cement, and keep a 1-yd. mixer supplied so that it can maintain an average delivery of 400 cu.yd. in a 10-hr. day. The mixing plant, cement storage and delivery hoppers are all located under one roof where work will not be interfered with by rainy weather.

Sand and stone are delivered in standard-gage bottom-

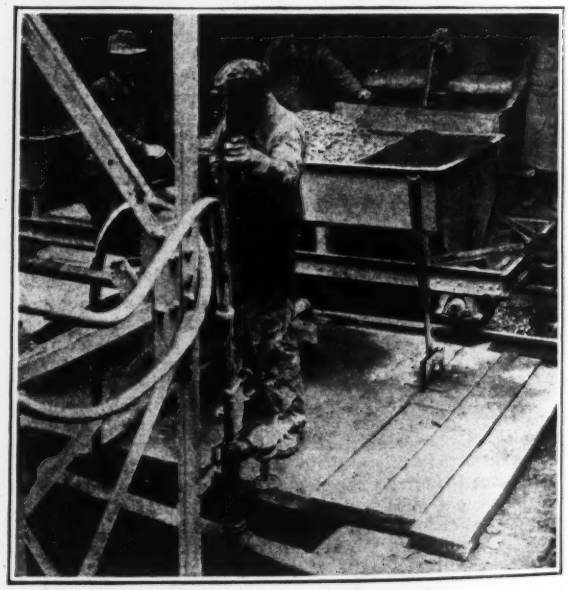


FIG. 1—CHARGING FLOOR
Batch hopper car and double cement hopper at center; cement storage at the rear; concrete mixer below operating platform.

dump cars which are run out on a trestle and dumped into wooden bins directly under the tracks and holding 400 cu.yd. of stone and 200 cu.yd of sand. On a narrow-gage track under the bins, a small gasoline locomotive hauls two specially designed steel bottom-dump batch cars of 1½-yd. capacity. These cars have two compartments, one for sand and one for stone. They are loaded by gravity from gates in the bottom of the sand and stone bins. When filled to capacity each car carries sand and stone for a 1-yd. batch of 1:3:6 concrete. The trestle, bins, and narrow-gage track are shown at the left in Fig. 2, and the batch cars in Fig. 1. When filled, the cars are pushed 50 to 100 ft. to a point directly over the mixer hopper, the mixer being in an underground pit. Here the contents are discharged by gravity and the cars are run back to the platform for another batch.

Cement is delivered in box cars which are run out on the material trestle to a point where the car door is opposite a wooden chute that extends through the roof of the cement shed, so that the bags slide into the building. The chute, see Fig. 3, is curved up at the bottom to hold back the bags; as one is removed at the bottom another is put in the chute by the man in the car. Thus the sacks slide down gently without breakage. Careful handling was necessary as the cement is delivered in paper sacks. Incidentally, the contractor insists on the sacks being sufficiently tough to withstand this handling.

As the bags of cement come from the chute they are loaded onto a hand truck of 50-bag capacity and moved to storage or to the mixer hopper. The shed has storage capacity for 8,000 bags. Cement for the mixer is put into two small bins with sliding gates located just above the mixer hopper. Each bin holds four bags or enough cement for one batch, so that a charge of cement is always ready.

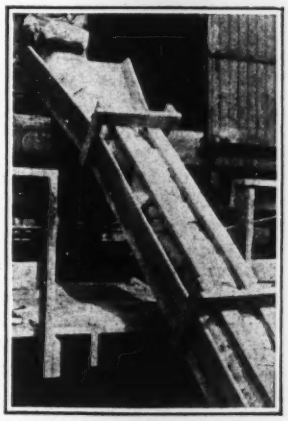


FIG. 3—SPECIAL CHUTE FOR BAGGED CEMENT

Eight men are required; one to run the small locomotive, one to charge and dump the cars, two to put cement into the chute from the box car, and four to handle bags in the shed, putting the cement into piles or into the charging bins.

The mixer discharges the concrete directly into the elevating bucket of a 105-ft. steel tower from which it is chuted across the main tracks into a 2-yd. receiving hopper (Figs. 2 and 4) placed on an overhead timber structure between two tracks. This hopper has a swiveling chute to deliver concrete to cars on either track, and is mounted on wheels so that it can be run out of the way if desired. From this hopper concrete is chuted into two 7-yd. hoppers mounted at opposite ends of a 45-ft. standard-gage flat car (Fig. 4). Two cars are used, handled by a 7-ton gasoline locomotive, one being loaded while the other is being moved to the point where the forms are ready for concrete. The two big hoppers have bottom gates and dump clean. Swiveling chutes are located under the hoppers to carry concrete to the forms. They are swung alongside the car when it is in motion. As the mixing plant is set up practically at the center of the job the longest haul is 4,000 ft.

Concrete for the north wall is discharged directly into the forms. For the south wall, the concrete for the footings is carried by chutes under the trestle from cars on the north track but for the main wall it will be discharged directly into the forms from cars on the south track.

This work, which is part of the track elevation of the four-track main line of the Pennsylvania R.R., includes 14,000 ft. of gravity-type retaining walls requiring 65,000 cu.yd. of concrete, 200,000 cu.yd. of filling, and

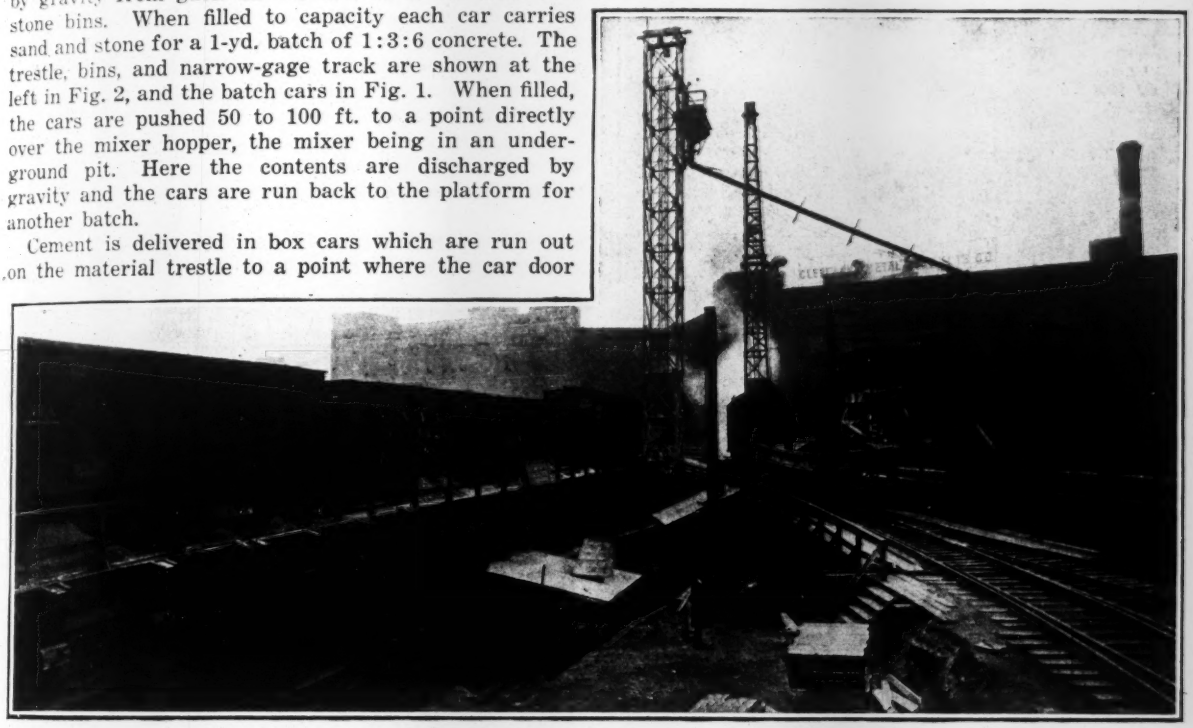


FIG. 2—CONCRETING PLANT ON CLEVELAND TRACK ELEVATION; PENNSYLVANIA R.R.
Sand and stone bins over narrow-gage track at the left; cement storage below to left of box car. Delivery hopper mixing plant below grade of narrow-gage track at tower; and concrete delivery car at right of crane.

steel bridges over nine streets crossed by the portion of the line under contract. The H. E. Culbertson Co., Cleveland, Ohio, has the contract for the concrete and

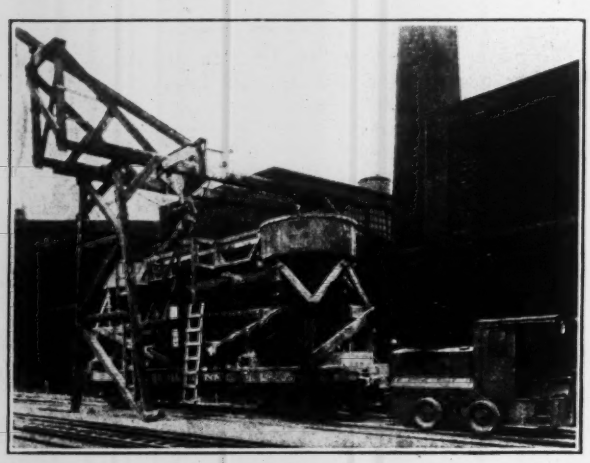


FIG. 4—CONCRETE DISTRIBUTING CAR
Concrete is delivered from the 2-yd. hopper at the end of the chute line to two 7-yd. hoppers on flat car for distribution to the forms.

filling. John Anderson is superintendent in charge. The work is being carried on under the direction of Robert Trimble, assistant chief engineer, Pennsylvania R.R., with C. A. Moore as engineer in charge. It is expected that the work will be completed by October, 1925.

Concrete Oil Tanks Reinforced With Outside Bands

Nominal Reinforcement Only in Body of Concrete Walls But Reliance Against Bursting Pressure on Tightened Hoops

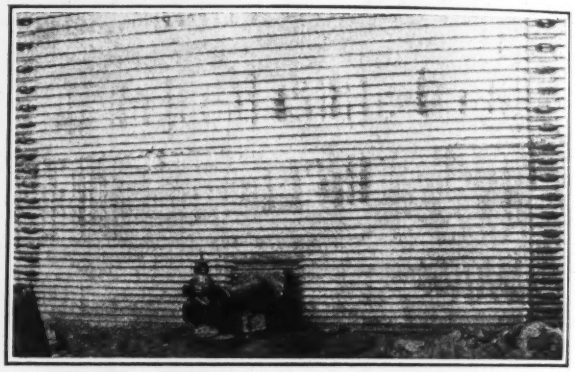
By Warren Travell
Chief Engineer, California Portland Cement Co., Colton, Calif.

IN REBUILDING their plant at Colton, Calif., during the years 1922 and 1923, the California Portland Cement Co. found it necessary to enlarge their fuel oil storage and it was decided to build three storage tanks, each of 20,000 bbl. capacity. As these tanks utilize the principle of hooping in resisting the liquid pressure of the tank content, the details of design and construction are thought to be worth while.

In the careful study which was made of existing concrete tanks, it appeared that the various failures and other troubles encountered in the past were largely due to the repeated changes in stress of the concrete and reinforcement steel of the side walls caused by the alternate filling and emptying of the tanks. There is no great difficulty in building a concrete structure to hold water or oil provided the concrete is protected against irregular shrinkage and is not subjected to tensional stresses. To obtain satisfactory results, it is necessary to use a rich, dense concrete taking care that this is well puddled during construction and properly cured during its period of setting. It is also essential that the design be such that shrinkage strains shall be evenly distributed and that, excepting these, the concrete shall at all times be in compression.

The effects of shrinkage and tension in reinforced concrete are now well known. Cracks caused by shrinkage of concrete during the process of hardening may be reduced to a minimum by the use of a small amount of reinforcement steel properly placed and by the exercise of care in keeping the surface of the concrete thoroughly wet for a period of several weeks after pouring. Such shrinkage cracks are of less importance in tanks for the storage of water than they are in tanks to be used for oil, as water has a tendency to close the cracks but with oil there is no such effect.

In the walls of circular tanks, as commonly built, circular reinforcing bars are embedded in the concrete to take care of tensile stresses resulting from the static pressure of the liquid with which the tanks are to be filled. The inevitable shrinkage of the concrete in setting produces a certain amount of tension in the concrete and a corresponding compression in the steel reinforcement. On filling with liquid after completion, the first effect is to increase this tension in the concrete to the breaking point thereby causing many of the shrinkage cracks to open wider and at the same time reducing the compression in the steel to zero. Further filling of the tank develops tension in the circular steel



EXTERNAL REINFORCING BANDS AND TURNBUCKLES BEFORE BEING COVERED WITH CONCRETE

reinforcement with attendant stretch and further widening of cracks in the concrete.

It is difficult to make these cracks watertight since, in general, they open up only when pressure is applied, which is when the tank is full, closing when the pressure is relieved.

Excessive changes of stresses in the sidewall reinforcing are likely to cause much trouble in large tanks. If the proportion of steel to concrete in the sidewalls is 4 per cent, the compressive stress in the steel resulting from the shrinkage of concrete will be approximately 6,000 lb. per square inch. When the sidewalls are subjected to static pressure, the concrete fails in tension and the stress in the steel goes to 10,000 or 12,000 lb. per square inch. Much of this change is likely to occur very suddenly, resulting in a weakening of the bond between steel and concrete and a possible cracking of the concrete in a vertical plane. The records of failures and partial failures of circular concrete storage tanks frequently show a spalling off of the concrete in a vertical plane through the reinforcing.

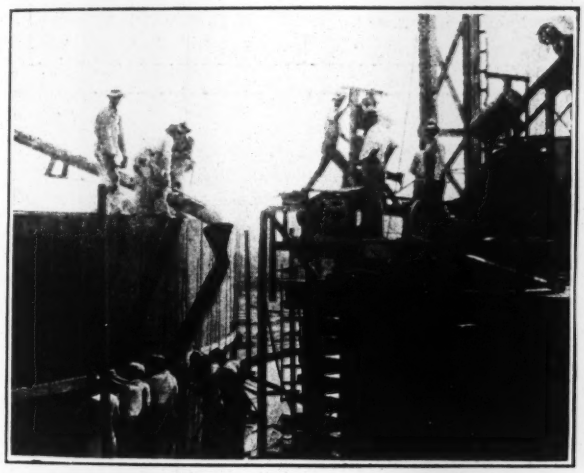
Another troublesome result of excessive change in the stress of the steel is the opening up of construction joints. This is especially true of the first horizontal joint above the base of the wall, where the base is prevented from sliding on its foundation. Attempts to provide a sliding joint between the bottom and the side wall are met with the difficulty of making a joint which will permit movement and at the same time re-

main watertight. If the sidewalls are rigidly attached to the bottom, they will be subjected to excessive bending which tends to open up horizontal cracks along weak horizontal planes. Such action is progressive in its operation due to the repeated filling and emptying of the tank and may cause ultimate failure to occur several years after the apparently successful completion of construction.

Design Details—All of these difficulties are met and overcome by building the sidewalls with but nominal reinforcement within the concrete and then placing steel hoops around the walls and putting such hoops under initial tension before the tank is filled. This method was used in the construction of the Colton tanks.

The three tanks are duplicates in all respects except pipe connections. The inside diameters are 94 ft. 8 in. at the bottom and 95 ft. 4 in. at the top. Sidewalls are 17 ft. high or 16 ft. from floor to flow-line of the overflow pipe. The walls are vertical on the outside, 12 in. thick at bottom and 8 in. at top, inside the steel hoops. Nominal reinforcement in the walls consists of ½-in. vertical rods, 18 in. c. to c., and circumferential tension rods varying from $\frac{3}{32}$ in., $2\frac{5}{8}$ in. c. to c. at the bottom to $\frac{7}{16}$ in., 18 in. c. to c. at the top.

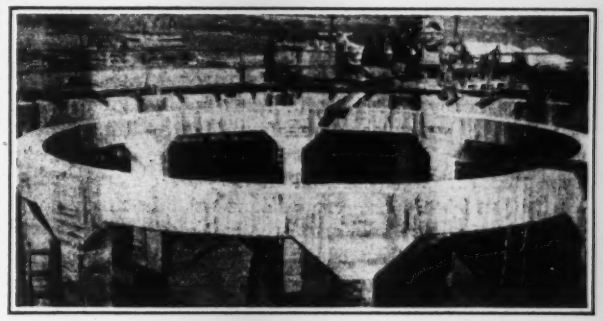
Excavations were made to the required levels and the footings for sidewalls and roof columns placed. The floor slab was next concreted, sloping to a large sump pit at the center. The roof columns and beams were then built to provide bracing for the sidewall



POURING CONCRETE WALL
Note revolving chute and number of men ramming concrete to insure dense mix.

forms. The inside forms for the sidewalls were made the full depth of the wall and in thirty-two sections, each about 9 ft. in width. These were set in place and securely braced to the columns and beams. The outer forms were also built in thirty-two sections but were made in three lifts, each about 6 ft. in height. This permitted thorough puddling of the concrete. After the concrete in the first section had been in place for a few hours, the top of the concrete was thoroughly cleaned of laitance by the use of wire brushes and water. The following day the next lift of the outside forms was assembled ready for the placing of another ring of concrete the next day. In this way, five days were required for building the circular wall of each tank.

Tightening the Hoops—As soon as the forms for the sidewall were removed, the work of assembling the adjustable rods was started. Each band was made up of eight rods, about 37 ft. long, connected by standard turnbuckles. Recesses had been molded in the outer surface of the wall to provide clearance for the turning of these turnbuckles. The rods were so assembled that in tightening the turnbuckles the levers used for the purpose were always moved down. These levers were of different lengths, being proportioned to the size of the rod, the stress required and the weight of the



CIRCULAR ROOF BEAMS OF TANK IN PLACE

man who was to use them. The work of assembling and adjusting these bands is the same as is required in handling wood pipe or wood-stave tanks. The bands were provided with rolled threads instead of upset ends and cut threads, as the section of rod where the threads were rolled was found to be stronger in tension than the body of the rod. This permitted the use of smaller turnbuckles and effected a considerable saving in cost. In order to use standard turnbuckles, odd sizes of rods were used. A rod of $\frac{13}{16}$-in. diameter rolls a thread to fit a 1-in. standard turnbuckle, a $\frac{9}{16}$-in. rod rolls to $\frac{5}{8}$-in. thread, etc. The rods used were of rivet steel with a yield point of 36,000 lb. per square inch.

In tightening the bands, an effort was made to get fairly uniform results and to get an initial stress in the steel that would result in zero stress in the concrete at the base of the tank walls when under full pressure. This initial stress was found to be about 12,500 lb. per square inch and all rods were stressed as near as possible to this amount. When the tank is under full pressure, the unit tension in the steel increases to about 16,000 lb. per square inch with no stress in the concrete. It will be noted that the total change of stress in the steel is only about 2,500 lb. and there is no change in tension in the concrete.

Lining the Tanks—As soon as the adjustable rods were tightened on a tank, it was filled with water. There were no leaks of any importance but where damp spots appeared on the outer surface, the inner surface was treated with a mixture of steel dust and cement. When the tanks were entirely watertight and moisture-proof, they were given two coats of "gunite" on the outer surface of the side walls and a thin coat on the inner surface. The outer gunite coating was altogether about ½ in. thick, carefully placed under the bands to give additional bearing and thick enough to protect them from corrosion.

After the middle tank was completed and had received its coatings of gunite, strain-gage measurements were taken on the sidewalls at several points. These points were about 30 in. apart, located in a vertical line on the north side of the tank. Readings taken be-

fore and after filling with water showed practically no variation.

The location of the tanks is but a short distance from our limestone quarry and about 100 ft. below the level of the quarry floor. On account of the danger from flying stones, the roof was made 8 in. thick and heavily reinforced. It was built in thirteen separate sections, resting on the sidewalls and upon circular beams supported by interior columns, the intention being that, in case a heavy stone should fall upon the roof, it would damage or destroy only the slab which it strikes, with no injury to the remainder of the roof.

An unusual feature of the construction is that no sand was used in the concrete, its place being taken by stone dust which had passed through a ¼-in. square wire mesh screen. Careful tests and previous use of this material in concrete construction at this plant indicated that the substitution of limestone dust for sand improves the strength and density of concrete rather than otherwise. The proportions used in mixing were one part cement, 1.4 parts crushed limestone passing a ¾-in. screen, 1.4 parts crushed limestone passing a ¾-in. screen, and 2.0 parts crushed limestone passing a 3-in. screen. The resulting concrete is very dense, weighing about 160 lb. per cubic foot. Exceptionally high values are also obtained in the tensile and compressive tests. With a somewhat leaner mixture, consisting of one part cement, 2.36 parts limestone dust to ¼-in., and 4.64 parts of ¼-in. to 2-in. limestone, the following results were had by a well-known testing laboratory:

40 days old, 3,759 lb. per square inch in compression;
1 year old, 4.403 lb. per square inch in compression;
8 years old, 5,324 lb. per square inch in compression.

A mixture of 1 part cement to three parts limestone screenings, ¼ in. to dust, showed a tensile strength of from 600 to 1,000 lb. per square inch.

For measuring the height of oil in the tanks, rigid gages were installed with floats of extra large size. These proved to be very sensitive and accurate in operation, registering the oil level within $\frac{1}{16}$ in. Each gage rod works through a 4-in. steel pipe which is carried to a height of 16 ft. above the roof, and this provides the only vent for the gases which are discharged from a tank during the filling operation.

The three tanks were completed early in January, 1924, and on being filled with oil showed no leaks nor dark spots on the outer surface. The accompanying photographs show quite clearly the various stages of construction and the completed work.

All of the work of construction was done by the company's own forces. William S. Hewett, Oakland, Calif., the inventor of this system of tank construction, was consulted in the design and execution. Mr. Hewett read a paper on this type of tank construction at the annual convention of the American Concrete Institute in January, 1923, and an abstract appeared in *Engineering News-Record*, Feb. 1, 1923, p. 217.

Line to Connect Canadian and Maine Railways

The Canadian Senate has approved construction of a railway connection between the Canadian National Ry. and the Maine Central R.R., about 16 miles long between Kingsclear on the Canadian National and a point near Harvey on the Canadian Pacific in New Brunswick, and then establishment of operating rights over the Canadian Pacific to Vanceboro, Maine, to a connection with the Maine Central.

Calculating Deflections of Beams By a Simple Method

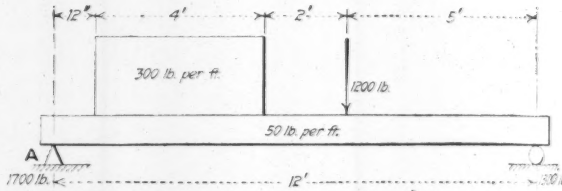
Procedure Based on Fraenkel's Formula—Summation of Products of Two Moments Along Beam Gives Deflection

BY PHILIP G. LAURSON
Assistant Professor of Engineering Mechanics, Yale University, New Haven, Conn.

THE METHOD shown below for computing the deflection at any point of a beam resting on two supports or of a cantilever beam requires no calculus. For this problem this method is, in general, simpler to learn and use than the area-moment method or the method of double integration of the equation of the elastic curve. A single reading of this paper should enable anyone familiar with bending moments to use and remember this method.

The deflection is found by the laws of work; this is probably the least often used of the methods for deflections of beams. It is thought that it has not been previously proposed in the present form as a simple, easy and non-mathematical solution of the problem. The formula on which the method is based was first stated in the form for beams by Professor Fraenkel of Dresden more than forty years ago.

Method—The method as here presented involves the



DEFLECTION OF THIS BEAM COMPUTED, EXAMPLE 1

computation of an area (which need not be drawn). The length of this area is the length of the beam; the height of the area at any point b is the product of two bending moments M and m. The first, M, is the bending moment at b due to the system of loads carried by the beam, while the other, m, is the bending moment at b due to a unit load resting on the beam at point a where the deflection is wanted. This area divided by EI (modulus of elasticity multiplied by moment of inertia) is the deflection required. Any method for finding this area may be used, but the one illustrated in the example below is probably the simplest and, though approximate, gives results sufficiently close as is shown by the example.

As E and I are always in inch units, the values M, m and the length should also be found in inch units in computing the area. However, in structural work it is generally simpler to compute these in foot units and then multiply by 1,728 when dividing by E and I.

To calculate the area, compute values of the ordinates (product of M and m) at regular intervals along the beam. The sum of the products of each of these ordinates by the common interval is the area. The use of Simpson's rule or other closer approximations is not justified. By taking the intervals small enough any desired degree of precision may be obtained. Labor is saved by making the common interval unity. This economy is in calculation of moments as well as in calculation of partial areas. Unless the beam is very

short or very long use unity as the interval. If the length of the beam is not an even number of units the short interval at one end is easily taken care of.

Example I—A 5-in. by 10-lb. I-beam spanning 12 ft. is loaded as in the adjoining sketch. Find the deflection at midspan. $I = 12.1$ in.^{4}; $E = 29{,}000{,}000$ lb. per sq.in. Tabulating moments for successive 1-ft. intervals we have:

Dist. from A	m	M (lb. - ft.)	Mm
1	.50	1,675	838
2	1.00	3,150	3,150
3	1.50	4,275	6,412
4	2.00	5,050	10,100
5	2.50	5,475	13,688
6	3.00	5,700	17,100
7	2.50	5,875	14,687
8	2.00	4,800	9,600
9	1.50	3,675	5,512
10	1.00	2,500	2,500
11	0.50	1,275	638
12	0.00	0	0
			84,225

$$\text{Area} = 84{,}225 \times 1 = 84{,}225.$$

$$\text{Deflection} = \frac{84{,}225 \times 1{,}728}{12.1 \times 29{,}000{,}000} = 0.415 \text{ in.}$$

This problem was worked by the area-moment method without any approximations and the calculations carried out to the bitter end on a calculating machine. The deflection thus found is 0.4112 in. The result as computed above is within 1 per cent of this.

The method may be applied without material change to cantilever beams and overhanging beams. The point whose deflection is wanted need not be between the supports. In such cases it is quite probable that for some points M and m will have opposite signs; their product is then negative, of course. If the final result is negative, the deflection is in a direction opposite to the assumed direction of the unit load.

The deflection or displacement found need not be vertical. For a displacement in some other direction simply point the unit load in the direction of the desired displacement and compute values of m that result from the assumed position and direction of the unit load.

Example II—The horizontal movement of the lower right-hand corner of the beam in Example I is wanted. Place the unit load at this point acting horizontally to the right. The values of m will be at all points $+2\frac{1}{2}/12$ lb.-ft. The procedure is otherwise the same as in Example I.

Theory—This method is based on the equation

$$d = \int^{l} \frac{Mmdx}{EI}$$

The first member represents the work done by a unit load as it moves through a distance d which is the deflection of the beam at the point where the unit load is placed. The second member represents the internal work done by the unit load as the "fibers" of the beam shorten or lengthen as the beam bends. The internal work and the external work are equal.

Those familiar with the calculation of the displacement of a joint of a truss by $\sum \frac{Pul}{AE}$ will recognize that this method is the same except that it deals with "fibers" in a beam instead of members in a truss.

To prove the formula, take a thin slice anywhere across the beam between two planes whose distance apart is dx. In this slice consider any fiber whose area is dA and whose length is, of course, dx and whose distance from the neutral axis is y. The unit stress on this fiber is $\frac{My}{I}$ and the change in length is $\frac{Mydx}{EI}$.

The stress on this fiber caused by the load of unity placed at some point on the beam is $\frac{my}{I}$. The force acting on this fiber due to this stress is $\frac{mydA}{I}$. The work done by this force while the fiber shortens or lengthens is therefore the force times the distance which is:

$$\frac{Mydx}{E \cdot I} \times \frac{mydA}{I} \text{ or } \frac{Mmy^2dAdx}{EI^2}.$$

For the whole slice the total work on all the fibers is the integral of this quantity over the cross-section. But as $\int y^2dA = I$ for the cross-section of the beam, the total internal work for the whole slice done by the unit load is therefore $\frac{Mmdx}{EI}$. The sum of this for all the slices composing the beam is $\int_0^l \frac{Mmdx}{EI}$, which is the total internal work done by the unit load as the beam deflects under the given loads.

Comments—Remember that the bending of the beam and the corresponding deflection are not the result of the unit load but of the other loads which the beam carries. If it seems that the effect of the unit load ought to be added to the effect of the other loads remember that the unit load may be assumed so small that its effects on stresses and deflections are entirely negligible. If the other loads are in pounds the unit load might be one milligram.

It is interesting to observe that $\int Mmdx$ may be regarded as a volume instead of an area. The length of the volume is l, the length of the beam. Every cross-section of the volume is a rectangle whose two dimensions are M and m. Another way of expressing this is to say that it is a volume whose base is the M-diagram for the beam and whose height at any point is the value of m at that point. In certain simple cases this volume can be computed conveniently and the desired deflection obtained in that way. This is, perhaps, the simplest way for a beam with only one concentrated load at any point when the deflection *at the load* is wanted. For this case the volume is two pyramids and it is easily seen that $d = \frac{M_1m_1l}{3EI}$ in which M_1 and m_1 are the values of the two bending moments at the load. Another expression for the same deflection is $d = \frac{M_1^2l}{3PEI}$ in which P is the concentrated load. Cases in which E or I or both are not constant throughout the length of the beam are easily handled by using $\frac{Mm}{EI}$ instead of Mm as ordinates of the area.

Maximum deflection—There is no very simple way of locating the point where the deflection is maximum in a beam on two supports. For symmetrical loading it is at the center. It is easily shown that, for a simple beam *without overhang*, the point of maximum deflection cannot be more than 0.077 of the length from the center. In this extreme case the maximum deflection is about $2\frac{1}{2}$ per cent greater than the deflection at the center. In all practical problems the maximum deflection occurs much nearer to the center of the beam and the deflection at the center will probably be within one per cent of the maximum.

Rapid Low-Cost Excavation of Drain Ditches

Organization of Work by Which 150 Miles of Ditch Were Built in Two Years To Relieve Waterlogging of Lands on Newlands Reclamation Project

BY A. W. WALKER
Engineer, U. S. Bureau of Reclamation, Denver, Colo.

DITCH excavation at greatest speed and lowest cost was demanded by the conditions under which the U. S. Bureau of Reclamation built a comprehensive drainage system for the Newlands reclamation project during the last two years. As set forth in a preceding description of the plan of the work (see *Engineering News-Record*, Sept. 4, p. 382), large areas of land on the project were seriously affected by waterlogging and the quickest possible relief was needed. A large and scattered territory had to be covered with the drains, so that it was important to build as many miles of drain as the available money would permit. A gratifying degree of success was attained. In two years' work seven draglines excavated 5,472,751 cu.yd. of earth, constructing 150.33 miles of drain. Before the work began, a board of engineers estimated that 100 miles of drain could be built for the available

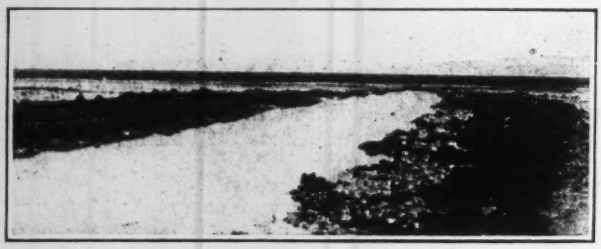


FIG. 1—OUTLET OF "L" DRAIN INTO CARSON LAKE

$700,000, but the work was done so cheaply as to increase this mileage by 50 per cent. The over-all cost of the ditches (including the cost of 1,034 culverts, bridges and other structures) was $4,656 per mile, in place of the estimated $7,000.

Organization—The work was handled by seven draglines: Two Class 14 Bucyrus; one Pawling & Harnischfeger type 208; three Monighan Class 1-T (1 cu.yd.); and one Austin No. 4 (½ cu.yd.). All the machines except the Austin half-yard machine were operated on a two-shift basis. The dragline crews furnished their own transportation to and from the work. They traveled on their own time, but on account of the

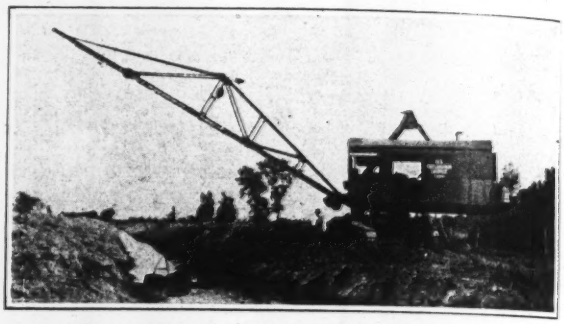


FIG. 2—DRAGLINE RECUTTING LOWER SODA LAKE DRAIN

long distances necessary to travel to and from the work an allowance of 6c. per mile was made for necessary automobile mileage. No mess house or commissary was operated in connection with any of the work; the men

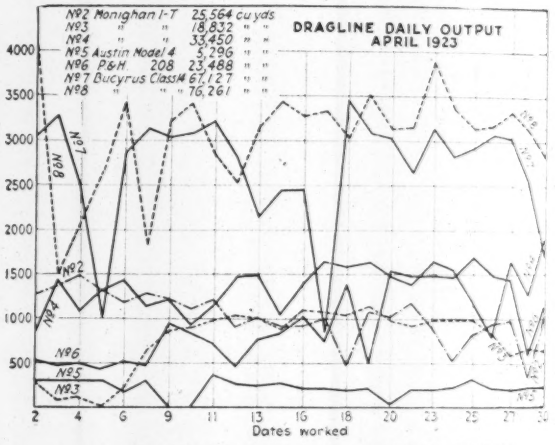


FIG. 3—CHART OF DRAGLINE OUTPUT POSTED ON ALL MACHINES

were entirely on their own resources for board and lodging.

At Fallon, which is at the end of a branch of the

TABLE I—COST OF DRAGLINE EXCAVATION, NEWLANDS DRAINAGE SYSTEM

Items of Cost	2 Class 14 Bucyrus Total Cost	2 Class 14 Bucyrus Unit Cost	3 Monighan Type I-T Total Cost	3 Monighan Type I-T Unit Cost	P. & H. Type 208 Total Cost	P. & H. Type 208 Unit Cost
Labor, machine crew	$39,524.38	0.012	$40,072.89	0.027	$16,249.45	0.026
Ground crew or pitmen	12,386.02	.004	15.15	.....	452.88	.001
Miscellaneous	565.00	.....	4.48	.....	62.50	.....
Power and fuel cost	41,606.84	.012	17,822.60	.012	7,454.00	.012
Hauling fuel	4,607.06	.001	3,302.13	.002	790.63	.001
Cost of water	741.68	.....	941.95	.001	129.88	.....
Lubricants	5,167.58	.002	4,955.05	.003	1,831.01	.003
Wire rope	4,908.93	.001	3,333.13	.002	1,763.92	.003
Transportation of crew	1,475.77	.....	1,402.05	.001	384.13	.001
Minor repairs and supplies	26,473.34	.008	14,862.66	.010	7,789.75	.013
Miscellaneous expense	199.29	.....	3.09	.....	83.16	.....
Plant charge	7,270.14	.002	2,808.42	.002	1,753.03	.002
Equipment charge	104,353.00	.031	38,826.50	.027	21,049.00	.034
Total	249,279.03	.073	128,350.10	.087	59,793.34	.096
Total yardage	3,400,202		1,470,308		624,545	
Total number of shifts	2,983.6	83.50	3,663.5	35.00	1,393.85	42.90
Average number of cubic yards per shift	1,140		401		448	

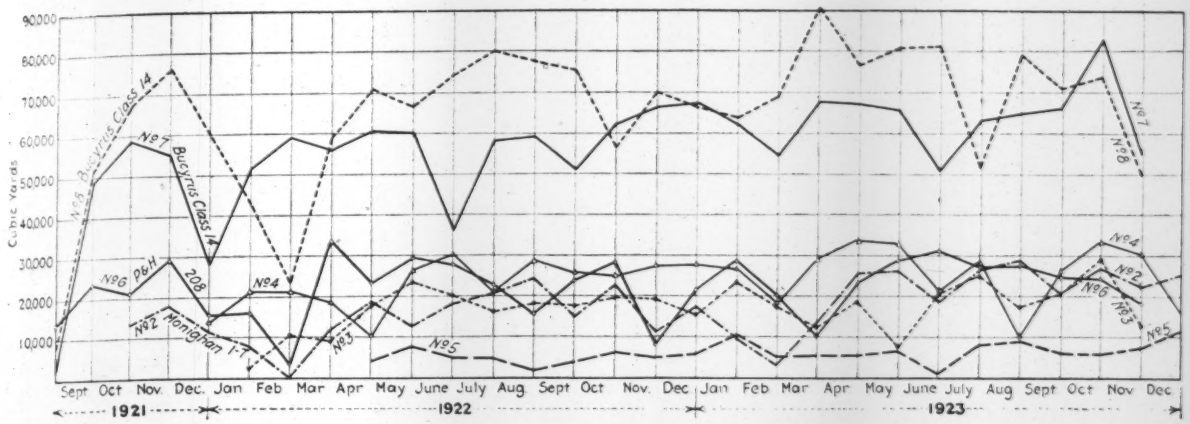


FIG. 4—MONTHLY MACHINE YARDAGE FOR WHOLE JOB

Southern Pacific R.R. and central for most of the work, were located a garage, storehouse, machine shop, blacksmith shop, carpenter shop, distillate storage tank, corrals and lumber yard. In the execution of all work machinery was used where practicable.

The regular hours for dragline crews were: day shift 7:30 a.m. to 4:00 p.m., afternoon shift 4:00 p.m. to 12:30 a.m., each with half an hour allowed for lunch. The shop crew was on duty from 7:00 a.m. to 4:00 p.m., with one hour allowed for lunch. The chief dragline operators in charge of the respective machines were on duty during the day shift. All necessary

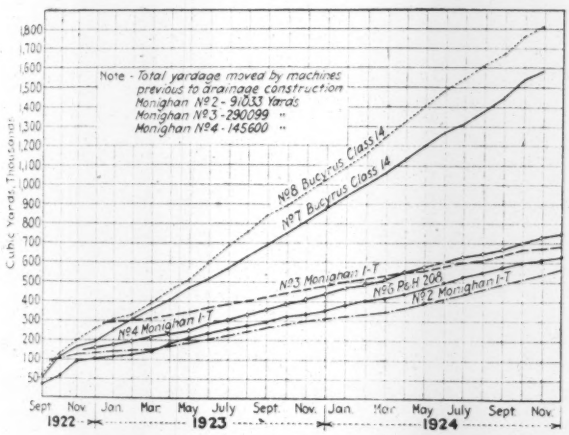

Cubic Yards, Thousands
Note - Total yardage moved by machines previous to drainage construction
Monighan No2 - 91033 Yards
Monighan No3 - 290099 "
Monighan No4 - 145600 "
No8 Bucyrus Class 14
No7 Bucyrus Class 14
No3 Monighan I-T
No6 P&H 208
No2 Monighan I-T
No4 Monighan I-T
Sept Nov Jan Mar May July Sept Nov Jan Mar May July Sept Nov
1922
1923
1924

FIG. 5—SUMMATION OF MACHINE YARDAGES

repairs as far as practicable were made on the day shift. Emergency breakdowns were taken care of as occasion arose by working overtime.

In the operation of all draglines the men were encouraged to work for machine output rather than high individual shift records at the expense of the machine or some other shift. The repair of machines was greatly facilitated by the use of a portable air compressor with necessary tools. This compressor was mounted on trucks and could be readily hauled from place to place on short notice. A great deal of time and money was also saved by the use of an oxyacetylene welding outfit. Considerable economy was also effected in the manufacture of brass and bronze bushings from stock made by recasting of scrap and worn material.

Fig. 3 is a chart showing the dragline daily output. This chart was issued regularly and posted on the various machines. A summary of operators' efficiency was also prepared and posted on the machines each month. This summary showed number of shifts for each operator for the month and to date, yards per hour actual digging time, yards per shift, machine cost per yard, and operator's grade in per cent and his order number. The grades and order number were based on average results in cost and rate of excavation produced by all operators on comparable machines doing the same class of major feature work. Average shift excavation was rated 50 per cent and average machine operation cost per yard was rated 50 per cent. Grades indicate whether the operator was above or below the average, by being over or under 100 per cent. The men took a great deal of interest in these records and a fine spirit of co-operative rivalry was developed, which materially increased the output of the machines.

Fig. 4 shows the monthly output of the several machines for the entire job, and Fig. 5 the summation of yardage of each machine. The summation yardage of all machines engaged on the drainage contract is plot-

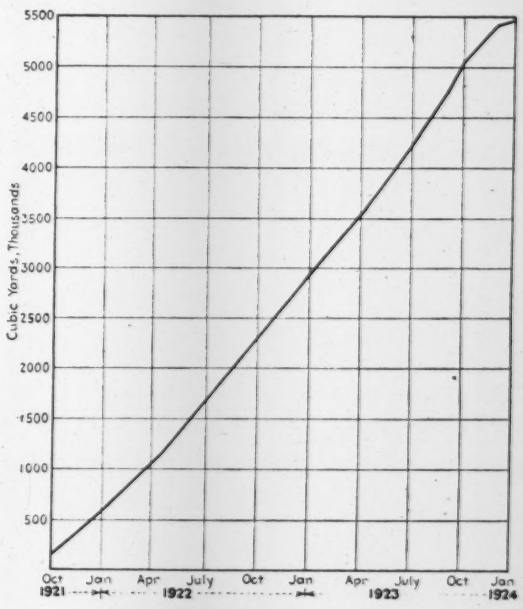


FIG. 6—PROGRESS OF EXCAVATION

ted in Fig. 6. All the charts were a ready and valuable reference during the job. They show conclusively that the work went forward in an orderly and well planned manner.

Average Shift Output—From the records kept, the following average shift outputs are found for the different types of machine. The three Monighan Class 1-T draglines worked a total of 3,663.5 shifts, excavating a total of 1,470,308 yd., which gives an average of 401 yd. per 8-hr. shift. The two Class 4 Bucyrus draglines worked a total of 2,983.6 shifts, excavating 3,400,202 yd., or 1,140 yd. per 8-hr. shift. The Pawling & Harnischfeger type 208 dragline worked a total of 1,393.9 shifts, excavating 624,545 yd., or 448 yd. per 8-hr. shift.

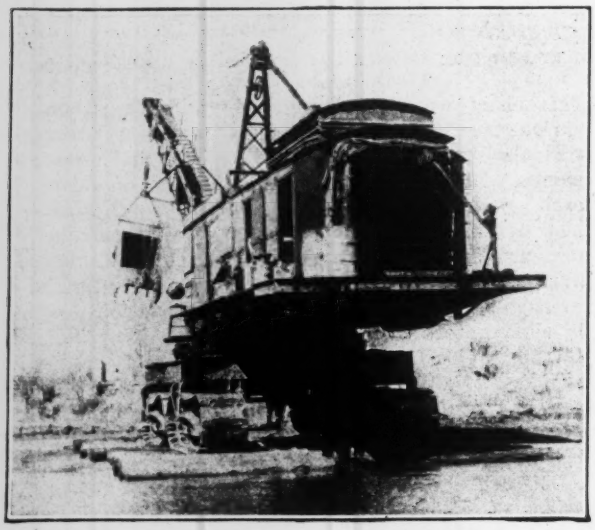


FIG. 7—CROSSING CARSON RIVER ON PONTOON MATS

Cost of Dragline Excavation—Table I details the average unit cost of excavation for each type of machine.

The question of plant account and depreciation of machinery received a great deal of attention and thought during the drainage job, and the policy adopted was conservative. The machines were put in first-class operating condition at the close of the job, at the expense of the contract. Table II shows the plant values at the beginning and at the end of the contract, and the repair cost.

It is believed that depreciation of machines should be at a net rate per shift. All cost of repairs and the like should be charged to operation. It is realized that in some months the unit costs would not mean a great deal, but the to-date costs are really the ones of value. However, it is seldom that extensive repairs are required on a new machine in the early stages of a job.

TABLE II—MACHINE VALUES AND DEPRECIATION

Machine	Number of Machine	Book Value When Transferred to Drainage	Book Value at End of Job	Cost of Repair and Plant	Total Machine Cost Per Cu.Yd.
Class 14 Bucyrus	121,476	$59,393	$14,000	$9,597	$0.035
	121,477	58,139	14,000	10,960	.030
Monighan 1-T	122,236	8,400	1,500	10,750	.037
	122,241	4,967	1,500	9,485	.033
	122,242	8,400	1,500	7,243	.024
Pawling & Harnischfeger, Type 208	121,270	22,842	7,000	6,124	.035

Fuel and Oil—The power on all the draglines was furnished by internal combustion engines burning No. 1 engine distillate, bought under specifications which called for water white engine distillate for use in internal combustion engines ranging from 45 to 175 hp. and operating dragline excavators. All engines are four-cycle, equipped with Schebler, Master or Bennett carburetors, and the distillate furnished was such as to work satisfactorily with these carburetors at an elevation approximately 4,000 ft. above sea level. The detail specification required that the distillate should be free from water and suspended matters, should have such distillation range that the first drop will be recovered at not more than 200 deg. F. and the end point will be not higher than 500 deg. F. At least 96 per cent was to be recovered as distillate in the receiver from the distillation. The distillate, delivered in tank cars, cost from 9⅜c. to 15½c. per gallon. Samples were taken from each car and analyzed by the U. S. Bureau of Standards.

Experience on this job and others has demonstrated beyond question the sound policy and economy of using high-grade oil for the lubrication of internal combustion engines. The main bearings of the Atlas engines on the Class 14 Bucyrus draglines were taken up less than one liner in 2½ years' service, during which time they excavated more than 3,400,000 cu.yd. The connecting-rod bearings are still good for about 2 million yards more, provided good oil is used.

In records kept during 1922 and 1923 it was found that each gallon of distillate would move 14.11 cu.yd. of material on an average for all machines. This record included the fuel used in moving from one job to another and maneuvering the machines.

Sewerage Problem of East St. Louis

SURROUNDED at high water by dikes necessitating the pumping of all storm water as well as sewage, East St. Louis is confronted with a serious situation. A recent report by Black & Veatch, consulting engineers of Kansas City, Mo., emphasizes the seriousness of the situation and lays out a tentative 30-year program.

Briefly, it is recommended that the present outlets be used for sanitary sewage of the unsewered section but not to include any additional territory for storm water. As the population becomes more concentrated (East St. Louis now has 72,000) intercepters will have to be built to reduce the present district from 3,516 to 1,686 acres. The first relief sewer, the Division St. line, should be built within four or five years at a cost of $320,000. Within 30 years, two trunk sewers, costing $4,000,000 and $3,528,980 respectively, discharging into the Mississippi below the water-works intake and below the present outfall will have to be built. Storm sewers in the north district depend so much on the solution of the Cahokia Creek cutoff problem that no recommendation is made. Definite work to be done immediately involves local sewers for built-up property in five suburbs at a cost of $691,000, the sewage to be pumped into the existing system so that it may be disposed of by dilution in the Mississippi River. No other treatment is considered essential.

Immediate action on the large intercepters cannot be had now by special assessment since it would mean a tax of $500 per acre on land valued at $4,000 and less. General bonds could not be voted as the valuation

is only $25,000,000, and the debt limit of 5 per cent has already been exceeded. Health demands that the sanitary sewers come first. They will increase the valuation, making the expensive intercepters possible later.

River Regulation Determined by Hydraulic Experiments

Laboratory Studies with Model Secure Successful Diversion of Destructive Currents Below Overflow Dam at Kilbourn

BANK EROSION on the Wisconsin River at Kilbourn, Wis., due to flood flow over the dam of the Southern Wisconsin Power Co., has been overcome by the construction of a concrete training wall, the location of which was determined largely by experiments made at the hydraulic laboratory of the University of Wisconsin. An aerial photograph of the situation, Fig. 1, shows the effect of the training wall in deflecting the current downstream (to the right) instead of into the eroded bay in the foreground. A heavy flood flow over the dam is shown in Fig. 2.

At Kilbourn, the river makes almost a right-angle turn and the dam is just above the bend. To provide for the large maximum flood flow, a dam of the overflow type was built across the entire width of the river, the forebay being excavated on the east bank, as shown in Figs. 1 and 3. The concrete crest is at El. 824, but within the dam are twelve gates 25 ft. wide, sliding vertically between concrete piers and rising 7.2 ft. above the fixed crest so as to give a maximum elevation of 831.2 ft. With a maximum flood flow of 63,000 sec.-ft. the head water is at about El. 840.2 and the tail water at El. 827.6, giving a direct fall of 12.6 ft.

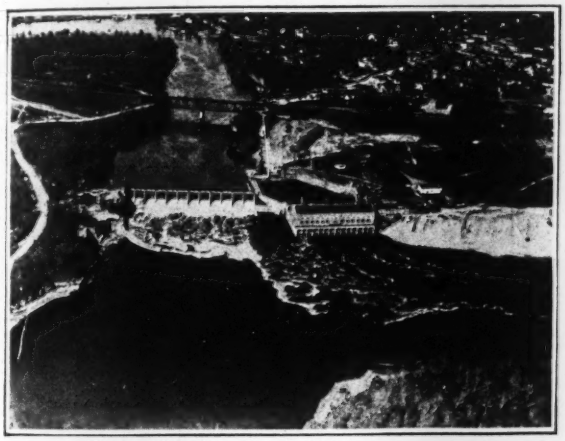


FIG. 1—EFFECT OF TRAINING WALL—KILBOURN DAM
Erosion in bay in foreground by flood water from dam checked by training wall at left, diverting current to main river channel at right.

Both above and below the dam the river flows between high sandstone bluffs, forming the "Dells" of the Wisconsin River, but immediately opposite the dam the bluffs are interrupted by the low sandy ground of an ancient stream bed. With the high velocity of water passing over the dam at high stages, the river gradually washed away the old sand bar and shore, forming a pocket or bay covering about eight acres and having a depth of 30 to 40 ft. Eddies formed in this pocket increased the erosion. Rock and stone revetment on the slope have been washed out from time to time, but steps were taken to stop this erosion when it threatened a public highway.

Training Wall—The best form of control appeared to be a training wall below the west end of the dam, diverting the flow directly to the river channel. This wall is 175 ft. long and 30 ft. high, built on bed rock and with its top at El. 822; its width is 14 ft. at the bottom and 9 ft. at the top. It was built in 20-ft. sections within cofferdams of plank sheeting, concrete being placed under water through a tremie. This structure was completed in the summer of 1922. A spring flood in 1923 submerged the wall about 3 ft. but was passed successfully, as was the less severe flood of 1924. The eroded area seems to be filling and riprap has been placed along the bank at the high-water line. Observations made during the 1923 flood showed effective prevention of cutting and substantial agreement with the results predicted on the basis of the laboratory work.

FIG. 2—HEAVY FLOOD AT KILBOURN DAM

Laboratory Experiments—In order to select the most effective position for the training wall, it was necessary to determine the original and altered directions of the currents. After a hydrographic survey and study of the currents in the river, numerous tests with a model of the river and dam on a scale of 1:100, were made at the University of Wisconsin. The results of these

FIG. 3—MODEL OF RIVER FOR HYDRAULIC EXPERIMENTS
Dam and training wall at rear. Eroded bay in foreground. Downstream river channel at right.

tests checked closely with the observations made at Kilbourn.

Charts showing the currents and eddies in the model enabled the effects of different protective works to be studied. One of the charts in Fig. 4 shows the currents with and without the training wall in the model. It shows also the location of two sets of groins designed uniform elevation by an engineer's level. From cords stretched in both directions across these stakes measurements were made for topography as shown on a contour map, small iron pegs being placed at the proper elevations. After wire netting had been placed for reinforcement, the surface was covered with cement grout which was troweled to the tops of the pegs to reproduce

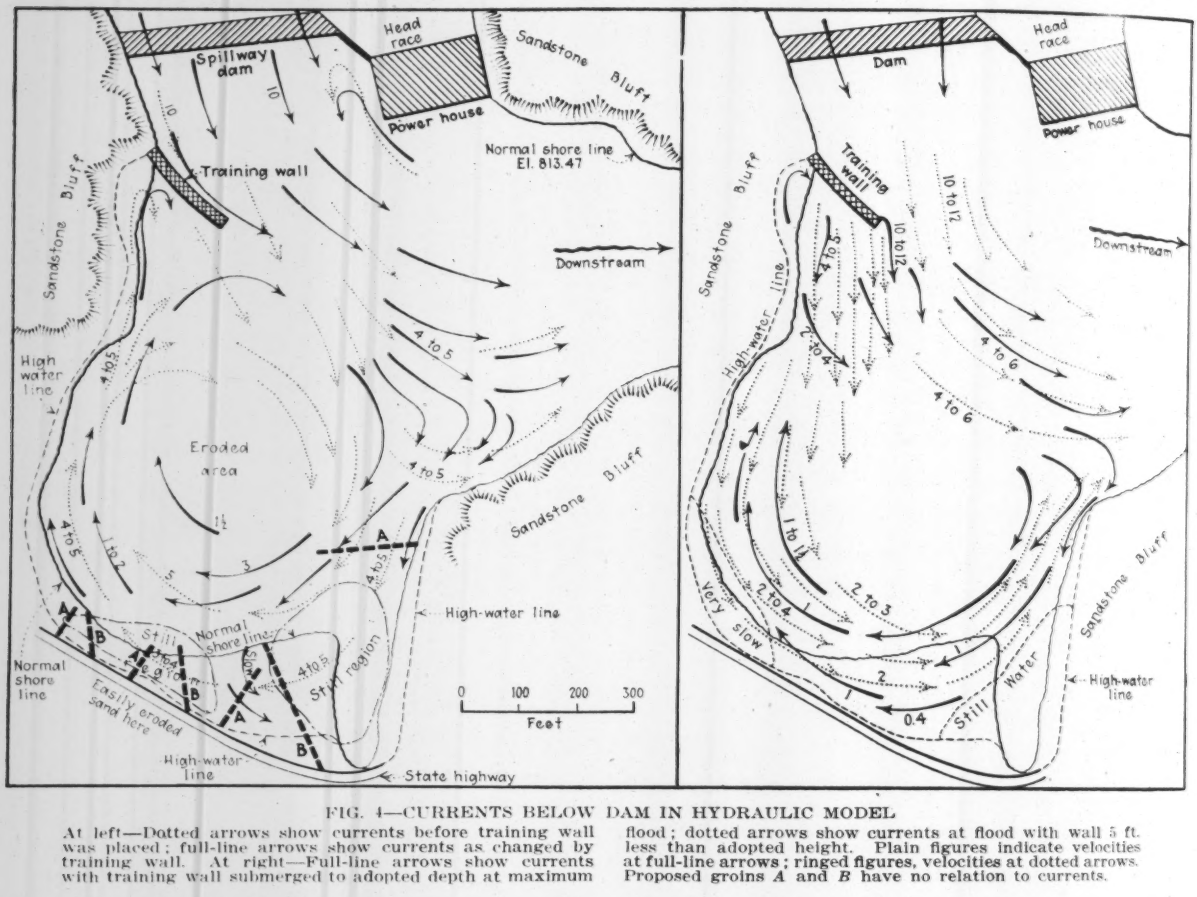


FIG. 4—CURRENTS BELOW DAM IN HYDRAULIC MODEL

At left—Dotted arrows show currents before training wall was placed; full-line arrows show currents as changed by training wall. At right—Full-line arrows show currents with training wall submerged to adopted depth at maximum flood; dotted arrows show currents at flood with wall 5 ft. less than adopted height. Plain figures indicate velocities at full-line arrows; ringed figures, velocities at dotted arrows. Proposed groins *A* and *B* have no relation to currents.

to break up the eroding eddies along the bank. While some of these groins proved successful in the model, the sandy bottom of the river made their use impracticable and they proved to be unecessary, since the training wall reduces the current so materially in the pool and causes zones of still water along the shore. The model wall was made in various lengths, with and without gaps.

In times of maximum flood the wall will be submerged about 5 or 6 ft. and the currents which will then exist are shown by the full line arrows in the second chart of Fig. 4. Experiments indicated that if the wall was built up above all flood-water elevation, there would be serious whirling in the pool. The dotted arrows show the currents with the wall 5 ft. lower than the adopted height. It was noted that with a certain height for the wall at maximum flood stage the water passing over it would counteract the whirl set up by the fast moving main stream. Studies of lesser floods showed satisfactory conditions with the wall at the adopted height.

For these experiments, ground was excavated for a model of the river on a scale of 1:100, Fig. 4. Stakes driven at 12-in. intervals along each side were set at the topography. Wood was used for the model dam, but the groins were of plaster. Lines of white paint marked the surface of the model into 12-in. squares. Small floats indicated the currents, their rate of travel at different points being timed by a stop-watch. Sawdust was used to show movements on and below surface.

Water was delivered to a baffle chamber above the dam by a 4-in. pipe fitted with a venturi meter so arranged that its gage would indicate various flood stages, thus enabling quick changes to be made in flood levels. A 1-in. pipe was also led to a small box to represent the tailrace discharge, a meter on the pipe allowing the flow to be adjusted to correspond with the normal outflow from the turbines. A device was provided also for the control of the downstream water level. The quantity of water to produce a discharge equivalent to a given flood was taken as 1/100,000 of the flood flow (or the 5/2 power of the ratio of the model); velocities were multiplied by 10 (the square root of the ratio) to determine actual velocities. Correction for the difference in friction between the river and the model was considered unnecessary and subsequent experience indicated that this view was correct.

The designs for this protective work were made by D. W. Mead and C. V. Seastone, consulting engineers, Madison, Wis.; Mr. Mead was consulting engineer for the company when the dam and power plant were built in 1908-1910. Under the suggestions of the engineers, the laboratory tests were made by C. I. Corp, professor of hydraulic engineering, University of Wisconsin, assisted by R. O. Ruble. Much of the above information as to the experimental work is from a paper by Mr. Corp. The construction of the training wall was done by company force, with N. A. Landt in charge, under the direction of R. G. Walter, superintendent of the Southern Wisconsin Power Co.

New Sewage-Works Replace Old at Marion After 18 Years

Imhoff Tanks, Sprinkling Filters, Secondary Tanks and Covered Sludge Beds—Twin Dosing Tanks Described

THE NEW sewage-works for Marion, Ohio, which were put in use on July 1, include bar gratings, grit chambers, a Venturi meter, Imhoff tanks, twin dosing tanks, trickling filters, secondary tanks and covered sludge-drying beds. They succeed works built in 1905, rendered obsolete by growth of the city, changes in the art of sewage treatment, and the discharge of the effluent into a ditch, dry except in wet weather. Besides obsolescence, the old plant had badly deteriorated physically, the concrete having disintegrated and the filter medium having become clogged and pulverized.

Both the two-story Imhoff tanks and the single-story secondary tanks of the new works have trough instead of hopper bottoms. The settled sewage is automatically pumped to tapered twin dosing tanks, illustrated herewith, which give a maximum effective head of 8 ft. at the nozzles over the entire 1.4 acres of 10-ft. depth, 1½ to 2½-in. limestone filters. Facilities are also provided for flooding one-fourth of the filtering area to minimize fly difficulties. The final effluent is discharged into the Little Scioto River.

The plant is designed to take care of the sewage of 40,000 persons, or an average of 4 m.g.d. It was treating only some 1.5 m.g.d. within a month of the time when it was put in operation, when the indications were that the filters were seeding properly and that everything else was functioning well. Adequate laboratory and office facilities are provided at the plant.

The new works were designed and built under the direction of George B. Gascoigne, consulting sanitary engineer, Cleveland, Ohio. The plant is being operated under the direction of O. A. Benedict, service director, with Floyd G. Browne, superintendent and chemist in direct charge, and under the general supervision of F. W. Jones, a member of Mr. Gascoigne's staff who was formerly supervising chemist of the Fitchburg and later of the Cleveland sewage-works.

Dosing Apparatus—The twin siphonic dosing apparatus and its operation are described by Mr. Gascoigne:

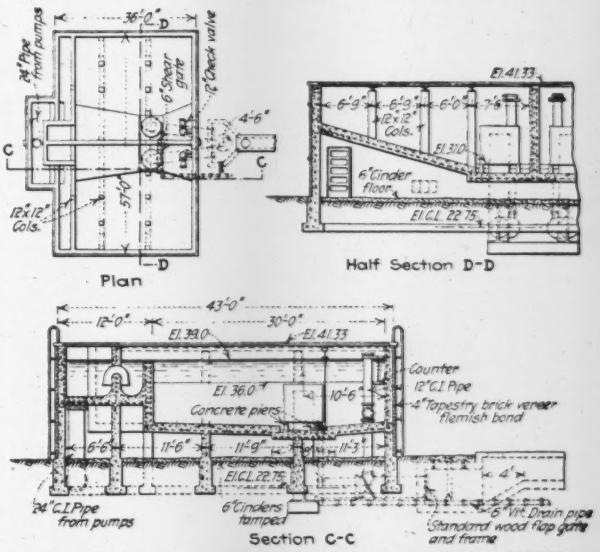
From the pumping station the sewage is delivered through a 24-in. cast-iron pipe to a header channel which permits the sewage to flow to and through either one of the 12-in. 5-ft. Adams feeding devices. These devices connect to each of the twin dosing tanks containing the 30-in siphon. Assuming the sewage to be discharging into one of the dosing tanks, then when the water level reaches a predetermined point a portion of the flow is spilled over a weir into a small chamber which contains an auxiliary compression dome. As the water rises over this dome the contained air which has been trapped is compressed. This pressure is transmitted to the feeding device which is then operating, thereby shutting off the flow. An auxiliary siphon located in the compression dome chamber automatically allows the air to escape from the other feed device which starts the incoming sewage to flow to the other dosing tank.

Simultaneously with the closing of the feeding device above described, the pressure from the compression dome is transmitted to the main siphon dome which already contains a certain amount of air under pressure. The added pressure then causes the seal on the main siphon dome to be blown and the contents of the dosing tank are discharged. When the water level approaches the bottom of the siphon dome a small seal is broken and the siphon "sniffs" or quits discharging. This completes the operation of one side of the twin dosing tanks, the other chamber operating similarly. The total time of the discharge of a dosing tank is about five minutes from blow to sniff.

The number of doses discharged by each of the siphons is recorded by an automatic float register or counter. In this manner a check is made of the amount of sewage applied to the filters in any period.

The two siphon legs terminate in a common chamber and are each fitted with a counterweighted wooden flapgate. This chamber is directly connected to a concrete box-shaped conduit from which the distribution laterals extend.

Old Sewage and Garbage Plants Abandoned—The earlier sewage-works was completed in October, 1905,



TWIN DOSING TANKS FOR MARION SEWAGE-WORKS

with George H. Pierson, of New York City, as engineer. It consisted of 1-in. mesh screens, grit chambers, septic tanks, an aerating channel, contact beds and intermittent filters, the last composed of sand on broken stone. (See *Engineering News*, Feb. 22, 1906, p. 197, for description written by the late R. Winthrop Pratt while engineer of the Ohio State Board of Health.) The original intent was to put both the screenings and the matter detained by the grit chamber through a garbage incinerator, one wall of the building housing which rested on a part of the wall of the grit chamber. The incinerator was built under a license from Robert L. Walker, patentee, and had a capacity of 30 tons a day.

Both the old incinerator and the old sewage-works have been abandoned. The garbage has been buried on land near the incinerator for some two years past. The old sewage-works was practically abandoned some three years ago. The effluent from it flowed into Rock Swale.

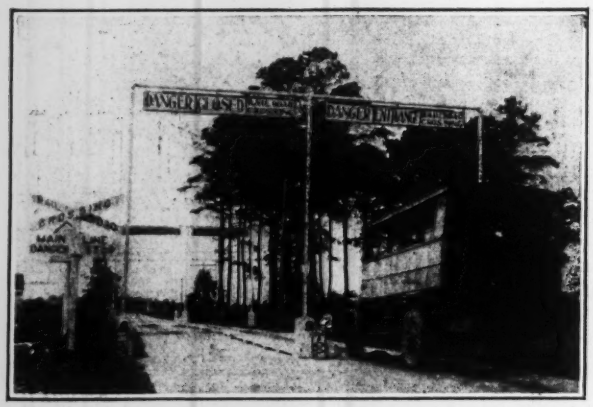
The population of Marion is now estimated as above 30,000; in 1900 it was 11,862; 1910, 18,232; 1920, 27,891.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Automatic Speed Control Device for Railroad Grade Crossings

ALTHOUGH some states have laws requiring vehicular traffic to stop before crossing a railroad at grade and most of them have statutes requiring, either directly or by implication, a certain amount of caution at such crossings, these statutes are seldom lived up to. In Virginia, where the law requires motor vehicles to come to a full stop at grade crossings, there are so many arrests for such violation of the law that the traffic police, who receive a portion of each fine collected, find the patrolling of grade crossings a lucrative business. To prevent such violations of the grade crossing law an arrangement has been designed and patented which not only serves as a warning to ap-



HIGHWAY TRAFFIC CONTROL DEVICE ON GEORGE WASHINGTON HIGHWAY, VIRGINIA

proaching motorists in addition to the crossing sign required by the statute, but requires the motorist to slow down before reaching the crossing and controls the lines of traffic over it.

The arrangement of the traffic control is shown in the accompanying illustration. It consists primarily of two barriers with appropriate signs. The barriers are so arranged as to provide two distinct passageways. In the middle of the right-hand opening approaching the barrier there is placed a large block, or saddle, approximately 8x12x38 in., cut out in the center so as to clear all parts of any motor vehicles, but offering sufficient obstruction so that care must be exercised by the driver that the wheels of the vehicle may straddle this center obstruction and still be within the outside limits. A 6x6-in. curb extends from barrier to barrier, except at the track, to restrict traffic to one or the other side of the road, preventing one motorist from cutting around the vehicle of another, blocking traffic from the opposite direction, and preventing possible accidents.

An important feature of this particular installation is the use of reflector lights. Four of these are placed on each barrier, the two right-hand ones approaching the crossing being green, the left-hand ones being red. The lenses of these lights, approximately 6 in. in diameter, are made of heavy glass and behind them are strong reflectors. These reflectors catch the light from the approaching headlights of the motor vehicles and illuminate the lenses giving the same effect as would high-powered lamps. The installation shown in the photograph is made of wooden blocks and iron pipe frame. It is intended that permanent installations will be made all of concrete and steel.

This particular crossing is one at which the state law was frequently violated and many arrests were made before the installation of the traffic control, in fact an average of over 200 per month. Since the installation of the barrier no arrests for such violations have been made. It is impossible for a motor vehicle to pass the barrier without slowing down sufficiently to amount to a full stop.

This device was designed and has been patented by J. C. Darst, of Portsmouth, Va., and is known as the traffic-control crossing warning. One such warning has been installed on a crossing on the George Washington Highway over the Virginian Ry. just southeast of Portsmouth, Va.

Utilizing Gas-Torch Welding in Building Construction

EXTENSIVE use of gas-torch welding for assembling structural work or for preparing structural members for connection by rivets is reported from a chemical factory by D. C. McGiehan of the Linde Air Products Co. A number of the process buildings of this plant are structures of considerable height with interior largely open, to accommodate plant apparatus. This arrangement required the provision of a large number of runways, stairs, platforms and balconies around and between the apparatus, together with piping, chutes and other metal interior work. Had this metalwork been ordered and fabricated by detail draw-

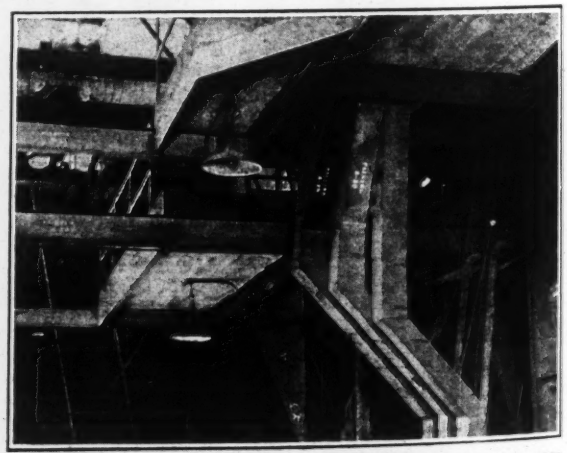


FIG. 1—TORCH-FABRICATED PLATFORM FRAMING AND WELDED CHUTES

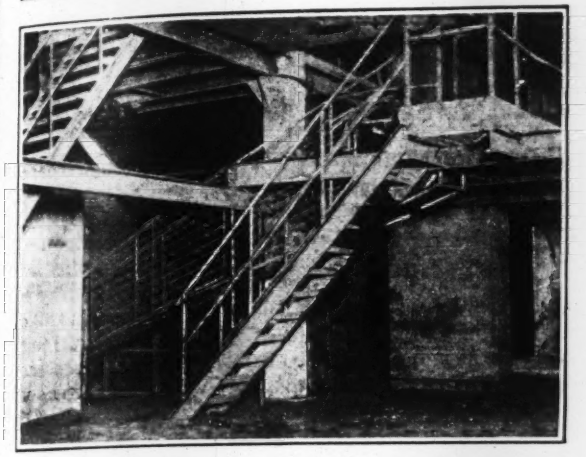


FIG. 2—CHANNEL STAIRS AND BELT GUARD

ings the preparation of the drawings, obtaining the measurement data for the various odd locations which the structures in question must fit, and finally the fabricated structures into place, would have involved much labor and expense. By the use of torch cutting, welding and rivet-hole burning, it became possible to fabricate and assemble all this interior metalwork on the spot, directly to fit, just as a carpenter will build a structure in place to fit conditions and dimensions as he finds them. This method of fabrication and assembly was further of advantage in that it permitted extensive use of second-hand structural steel which the plant had available.

The main framing of the building was shop-fabricated to drawings in the usual manner, and the torch was not applied here. Much subsidiary framing of the building was fabricated in place, however. Even many minor columns were built in this way. The sections (pipes or single I-beams) were cut to length with the torch, splice plates were cut and clamped to the columns where necessary, rivet holes burned through splice plate and main member simultaneously, and the two then assembled by riveting. Base and cap details and beam connections were dealt with similarly.

Platforms and runways in the plant were torch-fabricated throughout. Figs. 1 and 2 show examples of such work. The connections here were generally made by riveting, but the rivet holes were burned through clip angle and beam web after the members had been placed in position, and then immediately riveted to form the final connection. Most of the runways and platforms required to have railings built along their edges. In this case the beams were first placed and assembled, then 1-in. pipe posts for the railings were set upon the beam or channel flanges and torch-welded in place. After the floor forms had been set and the concrete floor slab poured, the railing was completed by welding lengths of 1-in. pipe to the tops of the posts to form the upper rail, and cutting and welding in shorter lengths to fit between the posts for the middle rail. All this pipe material was second-hand, from previous use in the plant. Where necessary for safety, steel plates or sheets were welded to the posts along the base of the railing to form toe boards.

Stairways were made by two methods, with channel stringers and pipe stringers respectively. Fig. 2 shows two stairways with channel stringers and Fig. 3 a pipe stringer assembly. In the case of the channel stringer the treads were attached to the stringers by clip angles, the torch being used for cutting treads and clip angles to length and burning the rivet holes. The treads, made of 8-in. channels, were laid flanges up upon the clip angles and tack-welded to them; finally the troughs of the treads were filled with concrete containing some steel turnings to give a safe roughened tread surface. In the case of the stairways with pipe stringers, 3-in. pipe was used for the stringers; transverse slots were burned along the inner edge (facing the tread space), and lengths of channels to form the treads were fitted into these slots and welded to the stringers with the oxyacetylene torch.

Besides the assembly of structural elements of this kind, a large amount of miscellaneous work was done by welding in this building, under circumstances that saved a great deal of time and labor over assemblage by riveting or by attachment by screws. This applies to pipe supports, attachment of electric conduits and wire supports, and particularly to chutes and hoppers. An example of chute work of welded construction appears in the view, Fig. 1. The crookedness of this work would have meant complicated development on drawings in order to permit of shop manufacture in the usual way. In this case the cutting and welded joining

FIG. 3—WELDED STAIR WITH PIPE STRINGERS

was done directly in place, to fit, thereby eliminating this development and doubtless saving much time. Straight lengths of chutes were made in the shop, but they were cut and joined on the job, while special sections were fabricated and assembled direct in place.

Another item of special work to which welding was applied in this plant appears in the background of Fig. 2, namely, a wire-mesh guard for a driving belt. This consists of pipe framing with fence-wire covering, all welded together. A great deal of miscellaneous welding work of this kind was included in the plant equipment. One item of special interest to the building man is the assembly of the roof drainage system, which is a bothersome item in many chemical plants because of the rapid corrosion of ordinary material by the chemicals contained in the drainage water. In this plant 4-in. pipe was split in half longitudinally with a cutting flame, the lengths of half pipe welded end to end, and the roof gutters built up of this troughing. Old boiler tubes welded together formed the downspouts.

Covered Trenches Protect Footings From Underground Water

By J. P. McMakin
Construction Engineer, North Carolina State Highway Commission

IN MANY states where highway work has been extensively carried on for a number of years specifications have become very rigid in regard to the placing of concrete in or under water in footings and foundations for bridges and culverts. As it is highly desirable that concrete be placed in the dry, the resource of the engineer and contractor is usually taxed to the utmost, particularly in marshy country where one has to contend with standing or flowing water, side seepage, or boiling springs.

One of the frequent causes for difficulty arises from deep excavations being made to conform as nearly as possible to the neat lines of dimensions shown on plans

INVERTED TROUGHS PROTECT FOOTINGS DURING POUR

for the actual concrete footings. Where cofferdams are necessary they are frequently not made sufficiently large to permit a pump sump to be placed outside of the neat concrete line. Where excavations are so deep that cofferdams are necessary they should be built large enough (from 2 to 3 ft. larger around than the neat line) so as to allow small trenches to be graded around the outside of the footing forms to catch and carry away side seepage water to the pump sump.

One of the most practical schemes of handling boiling springs and other ground water is to dig small trenches 3 to 6 in. below the elevations of the bottom of the footings connecting up in one line as many as possible of the springs and leading them to the pump sump or to the open trench outside of the footing forms. If necessary on account of scattered springs, additional trenches should be dug leading into the main trench or directly into the pump sump. After the water from the boiling springs has been collected into the trenches and is flowing into the sump, clean crushed rock or gravel, preferably 3 in. in size, should be placed in the trenches and each trench should be covered with an inverted trough formed by nailing two rough boards together.

Care should be taken to make a tight joint where one trough joins another. Tight joints prevent concrete from leaking through and obstructing the free flow of water in the stone-filled trenches. It may be necessary to cut a small hole in the bottom board of the footing form to allow the trough to project through the pump sump. It is found necessary in some cases where the bottom of the excavation is nearly level and water is standing or running in places not covered by the trough to spread a course of clean crushed stone or gravel over the bottom around and between the trenches. This will allow the water to work its way through the stone to the trenches ahead of the concrete. When deposited with a chute (the end of which is placed within a few inches of the stone) in one pile and worked ahead by tramping with the feet or by the use of a tamp the concrete fills all the voids in the loose stone and is not damaged by washing.

The accompanying photograph illustrates the method of installing trenches covered with the inverted trough with scattered stone between trenches. The footings shown are for a 24-ft. span arch bridge and are about 9 ft. in depth.

It will be noticed that the cofferdams were driven on the neat lines of the footings and that it was necessary to install the pump sump within the cofferdam. This gave rise to considerable trouble as it had to be boxed and carried up about 5 ft. in the footing. It was then necessary to remove the box, fill in about 1 ft. of crushed stone around a 2-in. pipe, pump dry, remove the pump hose and fill with practically one dump the remaining 4 ft. with a good stiff mix of concrete. The water immediately rose in the pipe and flowed continually until the pipe was cut off and plugged up after the concrete had thoroughly set.

From Job and Office

Hints that Cut Cost and Time

Lengthening Pipe Culverts in Widened Highways

WITH the rapid increase of vehicle traffic it often happens that a highway must be materially widened within a few years after it has been built. Often many miles of pavement are laid in limited widths in order that modern highway facilities may be had at once. As funds for more adequate widths become available engineers are then faced with the necessity of making plans for widening these highways with as little economic loss as possible. Under these conditions short-length bridges and culverts constitute perplexing problems.

The method whereby the Nevada State Highway Department has solved the question of culvert widening is told in the following paragraphs, which constitute part of a report made to George W. Borden, chief engineer, by C. C. Boyer, division engineer. The information for the article was supplied by the California Corrugated Culvert Co.

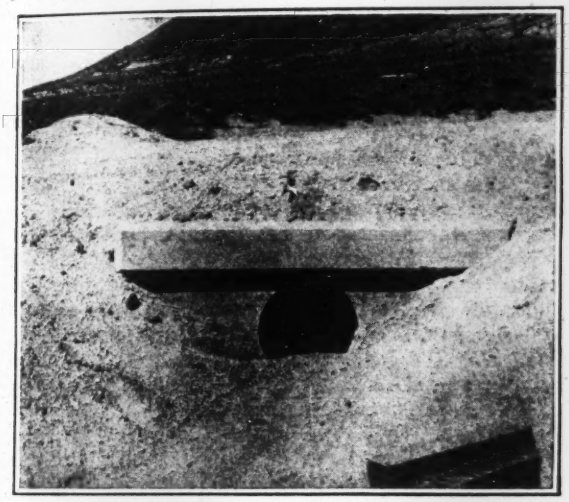
In his report Mr. Boyer says that 41 corrugated metal pipe culverts were extended. Each was extended 6 ft. and of the 41 lengthened 36 had headwalls which

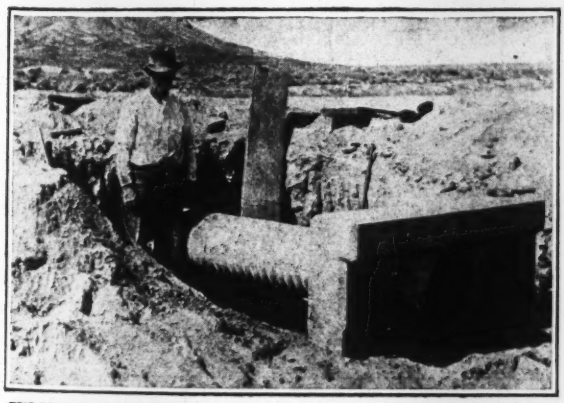
From Job and Office

For Contractor and Engineer

were moved the 6-ft. distance, the culvert being extended by the addition of a 6-ft. length of pipe and two band couplings of the proper size. Of the total number, 19 of the pipe culverts were 15 in. in diameter, 5 were of 18 in., 8 of 24 in., 2 of 30, 1 of 36, and 1 double 36-in.

The procedure consisted in excavating around the headwall and back about 2 ft. along the pipe behind the headwall. The excavation was carried to the bottom of the headwall footing and the new site, 6 ft. out, was prepared for the final position of the headwall. Using a special chisel, the pipe was cut about 1 ft. back of the headwall. This released it. The headwall was then jacked up at either end to a sufficient height so as to





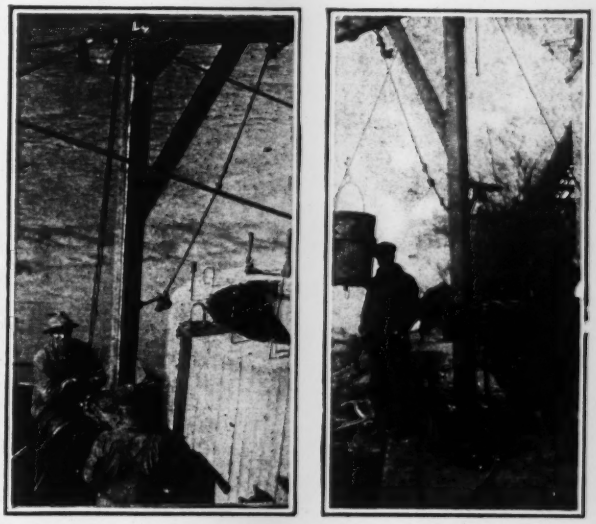
CULVERT BEFORE AND AFTER EXTENSION OF PIPE

allow the insertion of an 8-ft. plank upon which were placed two rollers and another short piece of plank. This short piece was immediately under the headwall footing. Upon the release of the jacks, the headwall was lowered onto the short plank and easily moved with crowbars to its final position.

The extension of the 6 ft. of pipe was made with two band couplings. The plank and rollers were removed by slightly jacking up the headwall, then lowering it so as to allow it to resume its final position. The only tools required were two jacks, two special chisels for cutting pipe, two crowbars, two picks, three 2-in. rollers made of old shafting, one piece of 2x6 plank 8 ft. long and one 2x6 plank 4 ft. long.

Small Hoist Used in Foundation Work

IN THE construction of the Virginia Power Company's plant at Cabin Creek Junction, West Virginia, 28 caissons were sunk to bedrock along the river bank



SMALL HOIST SPEEDS EXCAVATED MATERIAL HANDLING

preparatory to building the foundation piers. Caissons were 6 ft. in diameter, ranging in depth from 20 to 45 ft. When sinking of these caissons was started a bucket, handled by a hand windlass with two men using a gallows derrick having a swivel foot, was used to handle excavated material. This foot permitted the crossarm of the derrick with the bucket to be swung to one side so that the bucket could be emptied into a skip and the material hoisted to cars on the bank. Hoisting by hand became rather tedious, buckets making a speed of 25 to 30 ft. per minute. C. F. Boldman, superintendent in charge of construction, conceived the idea of using portable compressed air hoists.

As shown in the illustration these were mounted on the derrick upright. Their speed in hoisting the buckets and in lowering them was such as to cut the cost of hand hoisting two-thirds, and assured a rate of sinking caissons of one foot every two hours. After the foundation work was completed, the hoists were used in handling a large part of the 400 tons of structural steel required in the power house. The first part of the erection was done by means of ginpoles on the ground and later the hoists were set on the I-beams and the steel lifted directly. These hoists weigh under 300 lb. each and are rated at 6½ hp. with compressed air at 75-lb. pressure. They have a lifting capacity on a single line of 2,000 lb. hoisted vertically, or will haul a 100,000-lb. load on a level track.

The information from which this article was made was supplied by the Sullivan Machinery Co., makers of the Turbinair hoist.

From Job and Office

Hints that Cut Cost and Time

Alterations to Defective Flat Roof on Wisconsin State Capitol

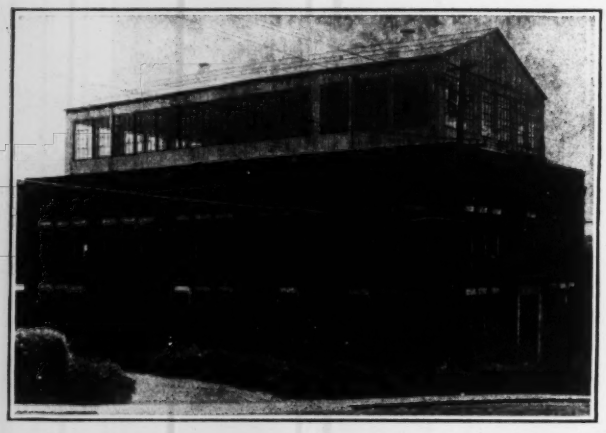
REBUILDING flat portions of the roof of the Wisconsin State Capitol at Madison, Wis., has been necessary to give better drainage and also to stop leakage. Each wing of the building, about 115 ft. wide over all, has a central pitched copper roof 46 ft. wide, flanked on each side by a 12-ft. flat roof and then a 15-ft. flat roof at a lower level, the latter forming a promenade. The flat roof and its relation to the pitched roof are shown in the accompanying typical section.

These flat roofs have concrete slabs which were covered originally with roofing felt and then a layer of asphaltum in which the promenade tiles of hard-burned clay were laid. One trouble was the cracking of the concrete roof slab, due to shrinkage, thus permitting water to enter the building and cause damage to plaster and decorative work. Another source of trouble was with the asphaltum layer for the tiling, which was of such composition that in summer it expanded and bubbled up, forming holes through which water entered, damaging the layer of felt and in winter freezing so as to lift the tiles out of position. It is the opinion of the state architect that asphaltum is not a good base for tiles, at least in the way it is commonly applied, since several other installations have been found with the joints bulged up and the material soft enough to stick to the shoes and thus be tracked into the buildings to soil floors and carpets.

To remedy conditions at the capitol it was necessary to remove the promenade tile and the asphalted felt, which latter was in bad condition and was further damaged in the process of lifting the tile. The concrete roof slab was thus exposed and wherever cracks were discovered they were repaired with portland-cement mortar. On some portions of the roof slab cinder concrete was applied to increase the pitch toward the waterheads. The roof was then covered with three layers of 3-ply roofing, making a 9-ply asphalt built-up roof. Upon this asphalt roof the promenade tiles were laid in a bedding of portland-cement mortar, with joints of the same mortar between the tile. This resulted in improving the appearance of the promenade roof. Few cracks have appeared in the tiling and none of these is serious.

This roof reconstruction was planned and carried out under the direction of Arthur Peabody, state architect of Wisconsin, and J. E. Hoyt, superintendent of maintenance at the capitol, the work being done gradually by the general repair force of the building.

Steel Building Tops Brick Structure



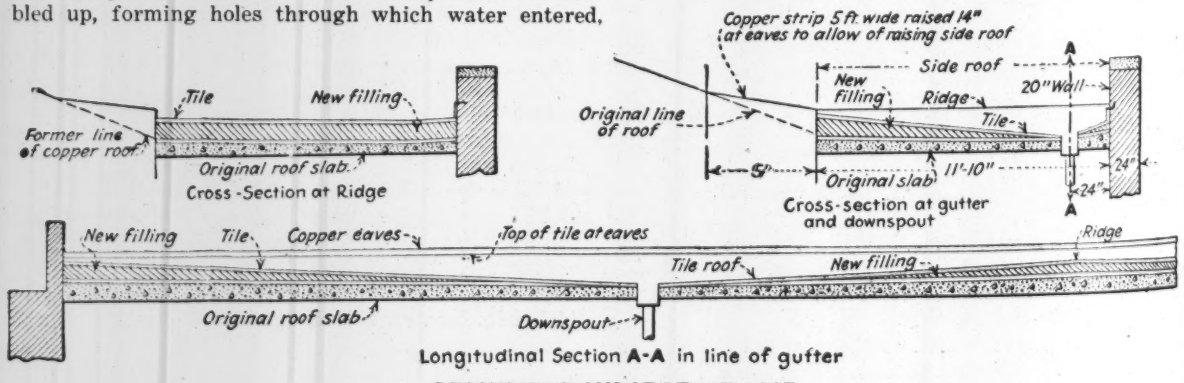
BETWEEN eight and nine thousand dollars was the saving represented in the erection of a Blaw-Knox standard steel unit placed on top of an existing two-story brick building, over carrying up the brick building an additional story. The standard steel building rests upon I-beams embedded in the side walls. The building was installed on top of these I-beams and anchored to them without disturbing the roof covering of the old building. The steel building sets about 3 ft. inside of the coping wall of the brick building. Sheet rock lines both ceilings and walls of the steel building.

Simple Rod for Taking Canal Soundings

BY E. K. DUPONT
Civil Engineer, Stockton, California

IN RECONDITIONING a drainage system of several miles of canal, it was necessary to obtain a bottom center-line profile and provide means of checking up the work done by the ditcher. The canal in question had vertical sides and a varying width of 12 to 20 ft.

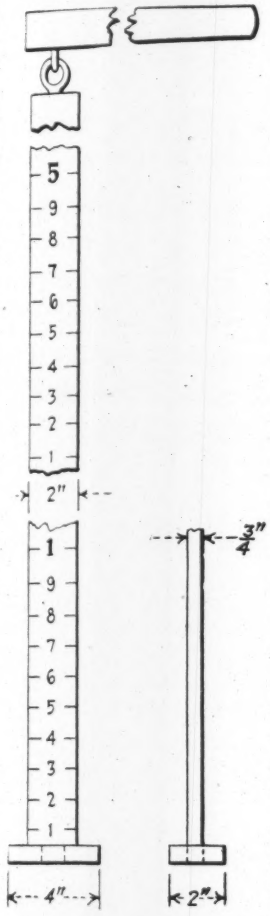
Reference stakes were set on one bank of the canal. Water gages, set from surface levels, were set at convenient points (about one-quarter of a mile apart) to serve as guides for both survey and ditcher crews. A



RECONSTRUCTION OF LEAKY ROOF

From Job and Office

For Contractor and Engineer



special rod was devised for this work made of ¾x2-in. pine about 5 ft. long, provided with a 2x4-in. shoe at the bottom, and marked in the usual manner. To the upper end was hinged, by two screw-eyes, a long handle which enabled the rodman to swing the rod out to the center of the canal, the recorder then noting the depth below water. The water line was noted at each gage station, as a check.

With two men, one handling the rod and the other recording, the progress was very rapid. At the wider portions, the recorder could help the rodman swing out the rod if necessary.

It is essential that the rod be made as light as possible. An advantage is had in graduating the rod on both sides. The handle should be somewhat longer than the half width of the canal. By graduating the handle the same device could be used to cross-section the canal bottom.

The same tool with a short handle was used by a single man to sound three miles of 10-ft. canal.

Abandoned Railway Trestle Used as Highway Bridge

CONVERSION of an abandoned railway into a highway scenic route in Colorado was recently accomplished, making accessible to motorists one of the most picturesque sections of the Pike National Forest.

The new highway known as the Summit Road and which uses about fifteen miles of the right-of-way of the old Cripple Creek Short Line R.R., is operated by W. D. Corley, of Colorado Springs, as a toll road. Mr. Corley purchased the right-of-way and the railroad at an auction sale. He junked the rails and rolling stock and converted a portion of the road into a highway. The purchase price of the property was $480,000. Since the purchase, Mr. Corley has spent about $200,000 in widening the roadbed and making the bridges and tunnels available for auto traffic. Under the terms of the permit granted by the U. S. Forest Service, Mr. Corley is to make a gift of the road to the government after he has collected in tolls the amount of money he has spent on the road and its reconstruction.

The Cripple Creek Short Line in the early days of the gold rush entered the Cripple Creek mining region. Though the present terminus of the road is about fifteen miles in the mountains at an elevation of 10,000 ft., it is proposed to extend the highway into the famous gold camp of Cripple Creek.

The information contained in this article is supplied by M. W. Bennett, editor of *Colorado Highways*, official publication of the Colorado State Highway Department.

RAILROAD TRESTLE CONVERTED INTO HIGHWAY BRIDGE

Correcting High Spots in Pavements

ENGINEERS everywhere are growing increasingly anxious to secure even-surfaced pavements, usually requiring that there be less than ¼ in. variations in 10 ft. The tool in the illustration is helping Illinois contractors meet the specification. It is a coarse carborundum brick held between two steel angles and provided with a wooden handle. When the concrete pavement is hard enough to bear the weight of the inspector, it is carefully checked with a straight edge. Any high spots discovered are ringed with paint. A workman then rubs them with the carborundum brick until they have been reduced to the proper elevation. A half inch of concrete can be removed from a 24-hour old pavement with little difficulty.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Colonel Sherrill Replies to the Societies

Sir—My attention has been called to your editorial of August 14, under the heading, "Reckless Words."

In order that the record on this matter may be complete, I inclose to you herewith copy of letters addressed by me to the American Society of Civil Engineers and to the Boston Society of Civil Engineers, in reply to charges made by committees of those organizations, concerning certain remarks made by General Beach and myself before the Joint Committee on Reorganization of the Government Departments.

In view of the publicity given by you to this matter and your editorial above mentioned, I would be glad to have you publish these two letters in full.

As you probably know, the reports of the committees of the American Society of Civil Engineers and of the Boston Society of Civil Engineers were drafted by former officers of the Construction Division, which division was largely responsible for the evils criticized in my hearings.

If any reckless words have been used in this controversy, it appears to me that they were solely used by the ex-members of the Construction Division, who wrote the reports in question. As I indicated in the above-mentioned letters to the American Society and the Boston Society of Civil Engineers, I would be glad to have these matters considered by a strictly unbiased committee of these two societies, the bulk of whose memberships I know would be above such petty animosities shown by their committees in the reports criticizing the remarks of General Beach and myself.

C. O. SHERRILL,
Lieutenant-Colonel, Corps of Engineers.

Washington, D. C.,
Aug. 29, 1924.

June 26, 1924.

The Board of Direction,
American Society of Civil Engineers,
33 West 39th Street, New York.

Dear Sirs—Receipt is acknowledged of the notice of your action of April 8th, upon a report of the Committee on Public Relations of the American Society of Civil Engineers.

The Committee on Public Relations has seen fit to criticize severely remarks made by me and your Board has seen fit to accept these criticisms and as a token of your approval thereof to transmit copies of the same to the Secretary of War.

The statements made by me and to which exception is taken were based on facts determined and publicly enunciated by the Select Committee on Expenditures in the War Department of the House of Representatives, Honorable William J. Graham, Chairman. These conclusions will be found in Report No. 816, 66th Congress, 2d Session, House of Representatives, House Calendar No. 190.

Without undertaking to cite the multitude of statements in the evidence taken before this Select Committee on Expenditures and without undertaking to repeat all of their findings and recommendations bearing on the subject under discussion, I wish to cite several of the findings and recommendations, which appear to me to be ample authority for the statements made by me before the Joint Congressional Committee on Reorganization.

I am quoted as saying that "Had such an arrangement existed previous to the late European war, it is doubtful if the government would have been subjected to the tremendous waste and graft that was connected with the construction activities suddenly thrown upon the War Department without an adequate engineering organization in existence to handle the emergency."

Also, "Take the graft and absolute loss of funds through graft to the government of over $80,000,000 in building camps. I feel no hesitation in saying that if that work had been under the Corps of Engineers, which as small as it was had the organization and the esprit de corps, that would never have happened; and, in fact, it did not happen in France where, under much greater difficulties, they did equally as great work without a single criticism."

The following quotations from the findings and recommendations of the Select Committee on Expenditures in the War Department are pertinent:

"Your committee believes that a serious and very costly error was made in not placing at least the engineering and utilities construction program at these cantonments in the hands of the Corps of Engineers. And your committee submits in support of this finding the accomplishment of the Engineer Corps in France under much more uncertain and difficult conditions, as to personnel, labor, tools, materials, knowledge of terrain, continual likelihood of harassment by hostile forces, and other extremely harassing factors. (P. 137.)

"Your committee finds that the fact that there was waste and inefficiency is admitted by those responsible for the adoption of the system, and charged with its administration. And the conclusion is inescapable that such waste spelled both delay and increased costs, and that the system failed, even by the admission of its advocates and administrators. And for that reason your committee finds the recent defense of the system by the Construction Division in its annual report, just printed, incomprehensible and inexcusable.

"Your committee finds that the error at the inception, which led to the grave results disclosed, lay in part in not using, consulting, or co-ordinating the various agencies of the government that were in existence. Under this head should be enumerated the following:

"(a) Failure to forthwith turn over engineering problems of all kinds to the very excellent Corps of Engineers that had a large and varied experience, and was in touch with the industry, through its branches, throughout the country, and had at its command the pick of the engineers of the United States; this in disregard of Army Regulations, Section 1493, then in force. (P. 140.)

"Your committee finds that the waste, idleness, and extravagance disclosed by the testimony taken at Camp Sherman and Camp Grant existed at other camps.

"Your committee finds that as a result of the system used the cantonments cost from 40 per cent to 60 per cent more than the amounts for which they could have been built. (P. 141.)

"Your committee finds, based on the testimony and carefully detailed estimate of a responsible contractor, that the saving which could have been made in the construction of a camp, which has been declared by the representatives of the Construction Division to be typical, and which your committee believes to have been less extravagantly built than a number of other cantonments, that an average saving could have been made to the taxpayers of the United States of about $5,000,000 per cantonment, or about $80,000,000 on the construction of the 16 National Army cantonments alone. (P. 141.)

NOTE—It will be noted that the waste stated above of approximately $80,000,000 holds for the construction of only 16 National Army cantonments and does not include some 15 or 16 other cantonments built under the same circumstances.

"Your committee finds that all peace-time construction of buildings and quarters, as well as engineering projects of all kinds, should be entrusted to the Corps of Engineers. The sole purpose of maintaining an army is to be ready for an emergency. Therefore, it is of the highest importance that the technical engineering branch shall be given in peace times the greatest variety of experience. Moreover, such procedure would avoid the necessity of maintaining the enormous, expensive, and extravagant duplicate branch now existing

as the Construction Division, which division, throughout the emergency, set in motion and permitted the continuance of inefficient, expensive, and dilatory methods of construction, with all the attendant graft, or near graft. (P. 141.)

"Your committee finds that the ordinary practice of having disinterested parties superintend work was not followed by the Emergency Construction Committee. Not only was the chairman himself, Col. Starrett, designated to superintend work done by the construction company of which his brother Paul A. Starrett was president, but in the instance of Maj. J. A. Pease, constructing quartermaster at Camp Gordon, he supervised the work of his former employees, Lockwood, Greene & Co., whom he employed as engineers. (P. 142.)

"The great discrepancies in the actual cost of cantonments is due entirely to the wide open cost-plus contract system employed and the opportunities which its administration offered for waste and graft. (P. 143.)

"Your committee respectfully recommends that Congress make provision to place all engineering and construction work for the army under the Corps of Engineers of the army. It is moved to this recommendation by several considerations:

"1. That the Corps of Engineers is distinctly the technical branch which should handle such work.

"2. The initial features of any construction work involve engineering. Therefore they are best fitted to start such work promptly.

"3. They are engaged in peace times in a greater variety of engineering and construction projects than any department.

"4. The sole ultimate purpose of having any military organization is to be prepared for an emergency. Therefore, if this corps is given in addition to its present peace-time duties all construction work, it will then obtain during peace times that complete variety of experience which will best fit it to meet the emergency.

"Your committee respectfully recommends that Congress refer this report and the testimony taken to the Department of Justice, with the request or direction that a complete and thorough investigation he made of all cantonment and camp construction projects, to the end of bringing to book those responsible for the losses to the government, and frauds through which they occurred, both by recoveries and merited penalties. (P. 148.)"

The testimony given by me before the Joint Congressional Committee on Reorganization and criticized by the Committee on Public Relations of the American Society of Civil Engineers was based on the findings of the Select Committee on Expenditures in the War Department, a few of whose conclusions are quoted above.

My statements were made from the record with the purpose of showing that the attacks being made on the Corps of Engineers, its record, its attainments, its efficiency in the execution of civil work by certain engineering societies, certain contractors and engineers for the avowed purpose of taking the construction of river and harbor work out of the hands of the Corps of Engineers and placing it in a Department of Public Works created for the purpose of taking charge of all such construction activities, and were, I believe, fully justified by the facts.

The statements made by me to which exception is taken by your Board and by the Committee on Public Relations were directed at evils of a system rather than at individuals or organizations and were extremely conservative as compared with the findings of the Select Congressional Committee on Expenditures in the War Department above referred to.

At this point I feel that it would not be amiss to mention the questionable procedure of a society of the standing of the American Society of Civil Engineers in joining with other associations and engineering and contracting organizations in persistent and unjustified attacks upon the Corps of Engineers, an engineering organization in good standing and many of whose members are reputable members of the American Society of Civil Engineers. There seems to be a strong feeling among many of the civil engineers of the country and among certain contractors that the wearing of a United States uniform stigmatizes its occupant and places him in an entirely different class from other professional men who are doing similar work and with similar training.

The organization of the Corps of Engineers is almost identically that proposed by the engineering and contracting societies for the proposed Department of Public Works, and I feel that a more adequate knowledge of the organization, methods and achievements of the Corps of Engineers by the civil engineers at large throughout the country should be fostered by the American Society of Civil Engineers, with a view to removing the misunderstandings which have been allowed to grow up largely as a result of the propaganda for the creation of a public works department.

I request that proper publicity be given to the above communication.

(*Signed*) C. O. SHERRILL.

July 5, 1924.

The Board of Government,
Boston Society of Civil Engineers,
715 Tremont Temple, Boston, Mass.

Dear Sirs—Receipt is acknowledged of your action of June 25, 1924, containing certain remarks made by me before the Joint Congressional Committee on Reorganization of the Government Departments.

For your information, I inclose herewith a copy of a letter addressed by me to the Board of Direction of the American Society of Civil Engineers, dated June 26, 1924, which gives the basis of the remarks made by me before the Joint Congressional Committee.

The Corps of Engineers of the U. S. Army has been for a number of years under persistent and most unjustified attacks by engineering organizations, and organizations of contractors interested in the formation of a public works department. This most unethical procedure has, so far as I know, never been criticized by your society nor by any other engineering society, nor do I find that your society has taken exception to the grossly unjust criticism of the American Association of Engineers in pp. 588 to 606 of the hearings of the Joint Committee on Reorganization of the Government Departments, which statements were introduced in evidence on Jan. 28, 1924, 3 days before the remarks made by me to which exception has been taken. The unjust and unfair attacks on the Corps of Engineers in the above mentioned papers are typical of the attacks that have been made by the proponents of the public works department for a number of years, and I would be only too glad to have a disinterested and an unbiased committee hold hearings on the controversy between the advocates of the public works department and the defenders of the reputation and standing of the Corps of Engineers, but I strongly object to the biased and grossly unfair action taken by your committee without having been given a hearing.

As indicated in my letter to the Board of Direction of the American Society of Civil Engineers, the facts stated by me in the hearing before the Joint Congressional Committee on Reorganization of the Government Departments are abstracted from the findings of the Select Committee on Expenditures in the War Department of the House of Representatives, found in Report No. 816, 66th Congress, 2d Session, House of Representatives, House Calendar No. 190.

The statements made by me to which exception has been taken by your organization were directed at the evils of a system rather than at individuals or organizations and were extremely conservative as compared with the findings of the Select Congressional Committee above referred to.

In view of the publicity which you have given to the report of your Special Committee, I request that equal publicity be given to this letter and to the accompanying inclosure, and that I be advised of the action taken.

(*Signed*) C. O. SHERRILL.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Tunnel Heading Advanced 600 Ft. During August

Work on Pit 3 Project Includes Continuous Timbering—Tunnel Section 22 x 23 Feet

Heading No. 1 on the Pit 3 tunnel which is being driven in northern California by the Pacific Gas and Electric Co. was advanced and timbered for a distance of 600 ft. in the calendar month of August. This is regarded as notable in view of the size of the tunnel (22 x 23 ft.), the kind of material traversed and the fact that continuous timbering set by the regular tunnel crew was included. A description of methods used in driving this tunnel appeared in *Engineering News-Record*, July 31, p. 168.

The progress noted above was made in three kinds of rock, tuff, agglomerate and seamy diorite, the distances in each being, respectively, 225, 225 and 150 ft. The wall-plate drift method was used exclusively in heading No. 1 and these drifts as well as the timber rings set ahead on the bench were as far ahead at the end of the month as they were at the beginning. As an indication of the kind of rock encountered it may be stated that although it was necessary to timber at the time of excavating, nevertheless the 600-ft. advance required the use of 7,625 lb. of 40 per cent gelatine in removing 9,660 cu.yd. of material (as muck this occupied an estimated volume of 12,000 cu.yd. on the dump.)

Bonus Earned

Each of the three 8-hour shifts included two shift bosses, 11 miners, 8 muckers and one shovel operator, 22 in all. All but the shovel operator participated in the bonus of 10 per cent of the day's wage for each foot driven in excess of 11 ft. per day. The regular wages (without bonus) are as follows: Miners $5.50; muckers, $4.50; shift boss, $6.50. The bonus for the month of August brought each man's pay up to within $1 per day of double the regular wage.

The three shifts of 22 men each placed all timbers (which were required to be within one-quarter inch of exact position) and in fact did all work at the heading. The only other workmen who came to the heading were drivers of the storage battery locomotives hauling muck and the men who maintained the track. The haul to the dump averaged about 4,000 ft. and the month's work represented a hauling job of 15,000 ton-miles. The air shovel used for mucking did not occasion any delays during the month but was out of service five hours at the completion of the month's run, for repairs.

The total distance driven in August at all five headings was 2,375 ft. and it is now expected that the tunnel will be completed by Jan. 1 and that the plant can be put in operation in July next year.

Association Formed to Develop Illinois Waterways

Promotion of the improvement of navigable waters in Illinois, where the work would be done by either the federal government or the state government is the main purpose of the recently organized Illinois State Waterway Association. The association announces its belief in the development of navigation and water power, the drainage of wet lands, the prevention of stream pollution and the conservation of areas for fish and water fowl. Fred Bennitt, attorney, Joliet, Ill., is president; L. D. Cornish, assistant chief engineer of the Illinois Waterway, Chicago, is secretary of the association.

Special Election to Be Held for Hetch Hetchy Water Bonds

A special election will be held in San Francisco Oct. 7 for the purpose of submitting to the people a proposed $10,000,000 bond issue to defray the cost of further construction work on the Hetch Hetchy water project; provision for this election having been made in the ordinance recently passed by the Board of Supervisors. Resolutions adopted by the board provide that no further elections for the consideration of water bond issues will be called during 1925, unless the measure to be voted on Oct. 7 fails of passage.

Of this $10,000,000 bond issue, $8,000,000 is to cover the cost of driving the 17-mile tunnel from Moccasin Creek into the San Joaquin Valley and $2,000,000 is alloted to shafts and other preliminary work on the 31-mile tunnel yet to be driven through the coast range mountains which separate the San Joaquin valley from San Francisco bay. This long tunnel through the coast range will be driven largely from shafts. Neither the cost of the coast range tunnel nor the 45-mile pipe line across the San Joaquin Valley is included in the forthcoming bond issue.

Action in the matter of the disposal of Hetch Hetchy hydro-electric power, it is understood, will be deferred until the California Railroad Commission has completed evaluation of the distributing systems of the Pacific Gas and Electric Co. and the Great Western Power Co. which is expected to be finished next June. Meantime work is progressing rapidly on the Moccasin Creek hydro-electric project (a part of the Hetch Hetchy development) and power over the city's transmission line from this plant is expected at the Newark switching station early next year.

Engineers Discuss Stresses in Multiple Arches

Am. Soc. C. E. Opens Fall Season—A. C. Janni and Professor G. I. Beggs Speakers

Analysis of multiple arches was discussed at the current season's first meeting of the American Society of Civil Engineers on Sept. 3. A. C. Janni presented the results of an elaborate graphical analysis of a series of three-arch spans supported on slender intermediate piers, showing that the outer spans have a large effect on the stresses in the central span. He recommended that in practical design the analysis of a series of arches be carried out by considering a sequence of three arches as independent, fixed between abutments, and the maximum stresses found in this series then applied to the design of all of the arches of the structure.

Prof. George I. Beggs dealt with the same general subject by aid of the method of determining the reactions of an elastic structure by measurements of deflections of a paper model, which he has developed during the past half dozen years. Following a brilliant exposition of this method in diagrams, pictures and working demonstration, he showed that in a multiple-arch structure of many spans the pier reactions are only slightly affected by loads more than one span removed from the pier in question, confirming Mr. Janni's recommendations in part; but that the arch thrust is considerably affected even through a long series of arches.

Practical Aspects Touched Upon

Discussion by D. B. Steinman, C. W. Hudson, O. E. Hovey and A. B. Cohen touched on some practical aspects of the subject, in addition to dealing with theoretical points. Dr. Steinman pointed out that elastic continuity in multiple-arch systems reduces the extent to which arch action is utilized, as distinguished from beam action. With piers sufficiently flexible, the arch thrust in a long series of arches may be reduced almost in ratio of the number of spans, as compared with the thrust of a single arch between unyielding abutments. Accordingly, the use of very flexible piers necessitates increasing the strength of the arches, and in certain practical cases it would be proper to determine by trial whether thin piers or heavier and more rigid piers give the best design. Mr. Cohen pointed out the value of studies of deformations and stress transmission in series of arches as a guide in deciding upon the best construction method with respect to type of centering and program of concreting, particularly in cases where one form of centering involves a greater risk of washout than the other.

Special Water Supply Commission for Boston and Vicinity

Two engineers and a former newspaper man have been appointed by the governor of Massachusetts as a Metropolitan Water Supply Investigating Commission "to study further the water supply of the metropolitan district and other communities which may require water from the metropolitan system, and of the city of Worcester," in accordance with a legislative act summarized in our issue of June 26, 1924, p. 1115.

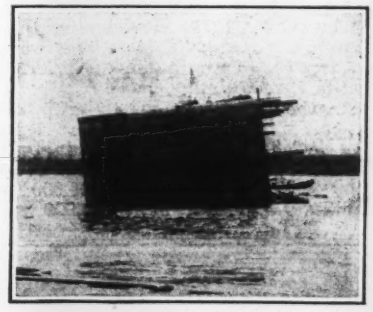
The engineers named are Charles R. Gow, consulting engineer, Boston, designated chairman of the commission, and E. E. Lochridge, chief engineer Water Department, Springfield. The third member of the commission is George F. Booth, formerly owner of the Worcester *Gazette* and prominent in the civic affairs of that city. The chairman of the commission will be paid $6,000 a year, and the other two members will receive salaries of $5,000 each.

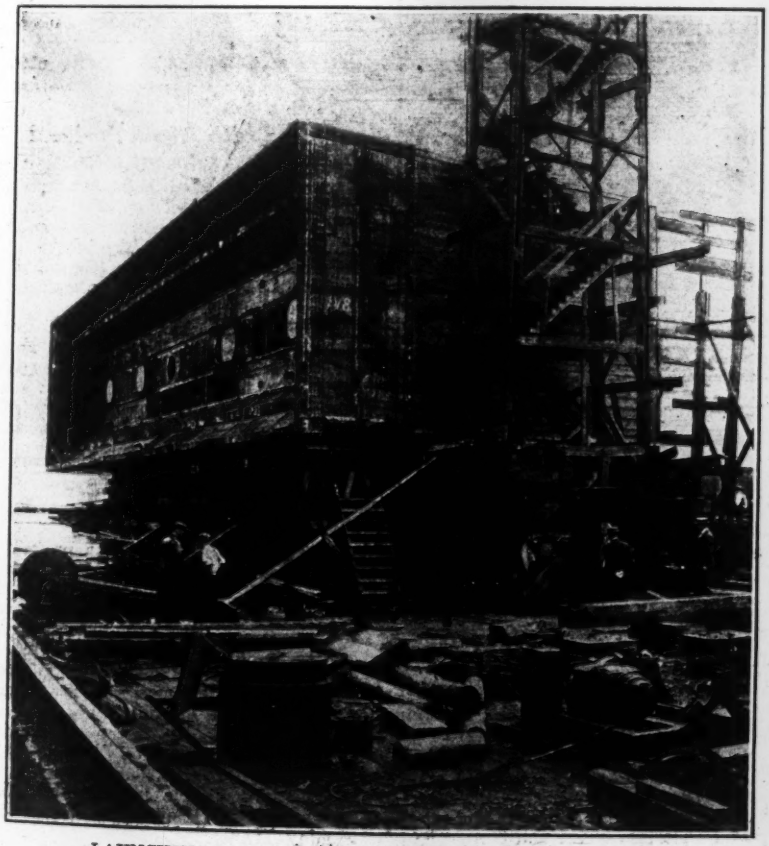
The act provides that the commission "shall employ as consultant a disinterested engineer of acknowledged professional standing, qualified as "a water-supply expert." The act also provides for a total appropriation of $100,000 for the investigations of the commission, but only $30,000 of this will be available during the current calendar year. The commission must complete its report by the close of 1925.

Buffalo Invites Bids for Garbage Disposal Plant

Bids for equipment for the disposal of the garbage of Buffalo by reduction and also for the disposal of mixed garbage and rubbish by incineration are to be received on Sept. 23. The equipment is to be installed within buildings and on foundations furnished by the city. If reduction is adopted, the plant will have a capacity of 240 tons a day for normal operation and a maximum capacity of 300 tons a day for six consecutive days. If incineration is chosen, the corresponding capacities in garbage and refuse mixed will be 400 and 500 tons a day.

No bids will be considered for a process or major equipment which has not been in satisfactory operation in municipal plants of comparative size in the United States or Canada for at least two years prior to Sept. 23, 1924.





LAUNCHING PIER CAISSONS FOR NEWARK BAY BRIDGE

Large Pier Caissons Built, Launched on Their Sides

Water Admitted To Working Chamber Rights Caissons Upon The Removal of Loading

In building four large pier caissons for the Arthur McMullen Co., to form the foundations of the main lift-span piers of the new Newark Bay bridge on the main line of the Central R.R. of New Jersey, the Federal Shipbuilding & Dry Dock Co. of Kearny, N. J., has followed the novel practice of building and launching them on their sides. These caissons 22 to 25 ft. wide by 97 ft. long, and about 45 high to top of permanent cofferdam, are of composite steel and timber construction, the cutting edge and roof of working chamber being steel, stiffened by steel trusses across the roof, while the structure above the roof consists of a shell of horizontal timbers braced by longitudinal and transverse strutting inside. The width of the caissons is not great enough to insure stability after launching except under such loading that the draft of the floating structure would exceed the safe depth limits in front of the launching ways.

One of the caissons at the moment of launching is shown by the view herewith, from a photograph taken on Sept. 3, when the third of the four caissons was launched at Kearny. The building slope is about ⅜ in. to the foot, and the slope of the ways about 1 in. to the foot. The caisson with cofferdam built to a height of 38 ft., ready for launching, weighed about 400 tons. The upper edge (opposite the steel cutting edge) was weighted with steel plates and bars, to improve the trim. The shafts which pierce the roof of the working chamber were bulkheaded, but the top of the caisson was left open except for a low splash bulkhead built along the edge which would be nearest the water after launching.

When the trigger was released, the caisson started promptly and slipped into the water smoothly. The cutting edge side floated lower than the top, due to its greater weight, only partly compensated by the loading of the top. The valved openings in the roof of the working chamber were opened, admitting water into the interior of the caisson, which with the help of removal of the steel-plate loading caused the structure to right and float in proper position. It was then placed in the large floating drydock of the yard, and the dock lifted, allowing the water to drain out through the valves in the working chamber roof and special drainage openings at the cutting edge. Then the concrete filling of the V-shaped space between side wall and sloping inner face of cutting edge was placed, this concrete weighing about 200 tons.

These caissons will support the four main tower piers of two lift spans, the longer one 305 ft. in span. Each is to comprise two double-track lift spans side by side, which will be the heaviest movable spans in existence.

The work is being done under direction of A. E. Owen, chief engineer, and J. J. Yates, bridge engineer, of the railroad company.

Coolidge Receives Delegation From A. A. E.

President Coolidge received on Sept. 4 a delegation representing the American Association of Engineers, who called to pledge the support of the organization in connection with any effort of the government to improve engineering conditions throughout the country. The delegation was composed of Harold Almert, Chicago, the president of the organization; A. N. Johnson, F. H. Newell, Morris Bien and A. B. McDaniel.

They told the President that their association has a membership of 16,000, with chapters in every important center of the population, devoting their energies to the welfare of professional engineers. They explained that the American Association of Engineers differs from the more technical engineering societies, in that its first consideration is of the human element. Mr. Coolidge was told that the basic purpose of this Association is to make the engineer a broader and more efficient man and to arouse his active interest in public service. They called his attention also to the fact that the Association at this time is initiating a national program dealing with fuel conservation, railroad valuation, the proposed department of public works and the classification and compensation of engineers.

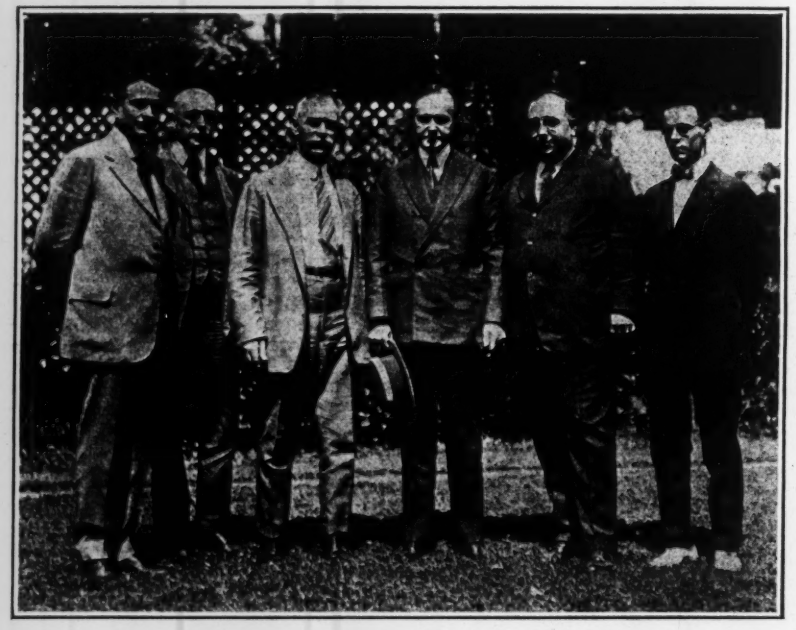
Report on Future Water Supply for Los Angeles

The Los Angeles Board of Public Works some time ago appointed a board of engineers consisting of L. C. Hill, J. B. Lippincott and A. L. Sonderreger to investigate and report on the water supply and requirements of the city of Los Angeles and the metropolitan area, the study to be devoted especially to water available in the vicinity of Los Angeles and from Owens Valley and Mono Basin, and to determine whether these sources would afford sufficient water to take care of the needs of the city.

The report, which has recently been submitted, states that Owens Valley and the Mono Basin will afford sufficient water to supply the area now included within Los Angeles City boundaries until about 1940 but no longer and that if the metropolitan area (that part of Los Angeles County below the high mountains) be included the sources named would be exhausted by 1933. Developing these additional sources to this extent would require the discontinuance of irrigation in Owens Valley.

As the city continues to grow and extend its boundaries, the report states, the city's requirements will approach those of the county; by 1940 the city was estimated to have 1,720,000 inhabitants and by 1950, 2,180,000 with a total of 3,270,000 in the county.

Press comment on the report points out that the 9-year period after which these sources of supply would be insufficient would be largely consumed by the time necessary to acquire rights and construct the aqueduct. From this it is argued that this report is further engineering evidence pointing toward the necessity of developing the proposed Colorado River source.



A. A. E. OFFICERS WITH PRESIDENT COOLIDGE
Left to right: A. B. McDaniel, F. H. Newell, Morris Bien, President Coolidge, Harold Almert, Leonard Smith

North Carolina Passes Port Bill

The Port Commission Bill has been passed by the general assembly of the state of North Carolina. It calls for a referendum on the proposal to issue $8,500,000 in bonds for port development and creates a commission to supervise port development with authority to purchase and operate a shipline.

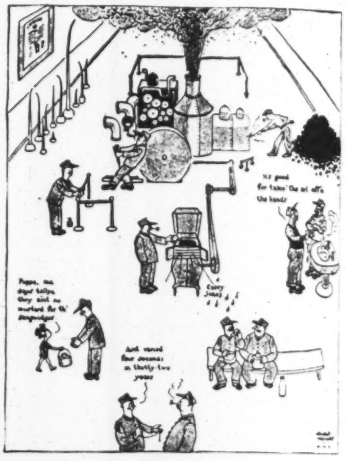
Random Lines

Who's Who in Engineering in Los Angeles

The city engineering department now has a total of 2,273 employees, as compared with 1,977 one year ago and 1,644 two years ago. There are in the department now 217 draftsmen, 350 street cleaners, 557 men engaged in repairing the streets, besides scores of truck drivers, garbage collectors, inspectors for sewers, street pavements, storm drains and other construction work done by private contracts.—From a Los Angeles newspaper.

* * *

A Cartoon From Life



INTIMATE GLIMPSES OF FAMOUS CLUBS
THE ENGINEERS

* * *

The Truth About Portland Cement

"The cement used in the construction of the bridge was 'Portland' as Portland cement was then known in the trade and generally used.

Since then eighty-seven separate corporations have come to manufacture Portland cement in 125 mills.

These cement factories stretch from coast to coast and, obviously the "Portland" product is not and cannot be uniform as to composition or quality.

Anybody who has the rock can make what is now called "Portland cement."

The name means nothing except as it serves a purpose for uniform national advertising.

All of the "Portland" patents have long since expired.

The claim is made that a prefix always precedes the word "Portland" but the printed advertising of the Cement Trust does not confirm this claim.

With more than $100,000,000 to be soon expended in cement hereabouts, all of the technicalities attending the production of "Portland" cement and the use thereof in all public construction must be of extreme importance to the taxpayers whose money is to go into this outlay of $100,000,000."—From a muck-raking article in a hitherto unknown (to us) newspaper called the Sunday Transcript, of Philadelphia.

Hirst Loses Nomination

In the Republican primary election held Sept. 2 in Wisconsin, Governor Blaine was renominated, though A. R. Hirst, former state highway engineer, received more than 140,000 votes out of a total vote of slightly more than 400,000. There were three candidates on the ticket.

Gulfport Proposes Sea Wall To Cost $2,000,000

The floating of a $2,000,000 bond issue to provide for beach protection on the Harrison County shores of Mississippi Sound, separated by a narrow strip of sandy islands from the deep waters of the Gulf of Mexico, will be passed upon by the voters of the county at an election to be held Nov. 4, in accordance with an order of the county board of supervisors issued Sept. 6.

The Harrison County Road Protection Commission, a body created by the last Mississippi Legislature, has recommended the building of 14.125 miles of sea wall, leaving the other 45 per cent of the waterfront for future protection.

The sea wall, as contemplated in the design recommended by the protection commission to the supervisors, will be a reinforced-concrete apron sunk in the sand to a depth of 8 ft. and extended 3 ft. above mean low water. It will be 9 in. thick. It will be constructed in 28-ft. precast tongue-and-groove sections.

The step wall, inclining backward from the apron, will be constructed with 18-in. treads and 12-in. risers. The step wall will be supported by reinforced-concrete piling, 10-in. square, set 10 ft. deep in the sand and spaced on 7-ft. centers.

The project as approved by the commission and by the supervisors, contemplates the building of a new eastbound highway at the top of the sea wall, providing a space between the new road and the existing road for the interurban tracks of the Gulfport and Mississippi Coast Traction Co.

Hobart D. Shaw, of Gulfport, is the protection commission's engineer.

Civil Service Examination

UNITED STATES

For the following civil service examination apply to the U. S. Civil Service Commission, Washington, D. C., or to any local office of the commission.

Surveyor - Draftsman — Vacancy in the Forest Service, Department of Agriculture, at Ogden, Utah, entrance salary $1,500 with possible promotion to $2.400; applicants must have common school education and five years' field and office experience, or be graduates of an engineering college with two years' such experience, and will be graded on education and on experience in plane, topographic and United States land surveying, and on drawing and lettering.

Applications will be received until Sept. 16.

Calendar

Annual Meetings

AMERICAN SOCIETY OF SANITARY ENGINEERING, New York City; Annual Convention, Philadelphia, Pa., Sept. 9-12, 1924.

CITY MANAGER'S ASSOCIATION, Lawrence, Kansas; Annual Meeting, Montreal, Que., Sept. 23-25, 1924.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.: Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 30 to Oct. 3.

AMERICAN CONSTRUCTION COUNCIL, New York City; Annual Meeting, New York City, Oct. 2-3, 1924.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, Detroit, Mich., Oct. 20-23, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Detroit, Mich., Oct. 23-25, 1924.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, San Francisco, Calif., Nov. 17-20, 1924.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The Engineers' Society of Western Pennsylvania held a special meeting Sept. 8 at Pittsburgh, at which Lieut. John A. Macready, of the engineering division of the Army Air Service, McCook Field, Dayton, Ohio, gave a talk on "Engineering Aspects of Flying."

Personal Notes

W. C. BROCKWAY has resigned as engineer for the Taxpayers' League of St. Louis County, Duluth, Minn., and has taken a position with the Philip Carey Co., Cincinnati, Ohio.

HARRY C. BOARDMAN has been appointed instructor in civil engineering at the University of Illinois. Mr. Boardman was graduated at the University of Illinois in civil engineering in 1910 with honors. From 1910 to 1916 he was draftsman and chief draftsman for the Chicago Bridge and Iron Works. He was lieutenant, captain, and major of field artillery during the World War and since 1922 has been draftsman and superintendent of construction for International Filter Co.

ROLAND HORTON has been appointed instructor in civil engineering at the University of Illinois. Mr. Horton was graduated from the University of Oklahoma in 1921. He has served about two years with the Benham Engineering Co. of Kansas City and about six months with the Public Works Department of Oklahoma City. During the past year he has been instructor in civil engineering at North Dakota Agricultural College.

KENNETH L. DEBLOIS, formerly concrete designer for the water-works of the city of Denver, Colo., has become associated with A. C. McGregor, consulting engineer, as designer of concrete and steel structures.

HERBERT A. OLSON, is now junior engineer with Hoad, Walker, Shoecraft and Drury, consulting sanitary engineers, Ann Arbor, Mich. Mr. Olson was formerly assistant sanitary engineer of the New Mexico State Bureau of Public Health.

EDWARD G. LEE, who until recently was principal assistant in charge of the office of Sawyer & Bean, civil engineers, Lewiston, Me., is now designing engineer for the Central Maine Power Co., Waterville, Me.

F. W. W. DOANE, city engineer of Halifax, N. S., recently resigned, and was presented with a watch by the civic officials in appreciation of his 33 years of service with the city. Mr. Doane will carry on a consulting practice.

J. A. DUCHASTEL, until recently city manager of Outremont, P. Q., has left Montreal to take up his new position as general manager of the Quebec Forest Industries Association, with headquarters in the city of Quebec.

G. R. WINSLOW, division engineer, Division 3, California Highway Commission, has been appointed to the position of assistant highway engineer in charge of maintenance, succeeding A. J. Wagner. The appointment became effective Aug. 16. F. W. HASELWOOD, assistant bridge engineer, has been named to succeed Mr. Winslow as acting division engineer in Division 3.

C. C. CRAGIN, chief engineer of the Salt River Valley Water Users Association, Phoenix, Ariz., at a meeting of the board of governors and council on Aug. 29, was granted an unsolicited increase in salary from $15,000 to $20,000. Officials of the association declare that they believe the increase was fully merited as it has been largely through Mr. Cragin's co-operation with the board of governors and with the president, F. A. Reid, that the Roosevelt project has been placed at the head of reclamation projects in the United States.

Obituary

CHARLES BROWN, resident engineer at the Moccasin Creek power house of the Hetch Hetchy project in California, was instantly killed Sept. 2 in a 200-ft. plunge of an automobile over a bluff between Sonora and Jackson, Calif. Mr. Brown was 35 years of age. He had been assistant chief engineer in charge of the construction of the O'Shaughnessy dam and had also been in charge of the building of the Alpine dam in Marin County.

HENRY P. HOEY, assistant engineer, Southern Pacific Co., died at Oakridge, Ore., Sept. 4, of apoplexy. He had been in charge of construction work on the Natron Cutoff.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Makers and Users Desire Fewer Manhole Varieties

Indorse Suggestion of Commerce Department for Conference of All Interests This Fall

MANUFACTURERS, engineers, and public utility companies have indicated to the Division of Simplified Practice, Department of Commerce, such hearty approval of the proposal to reduce the present wide range of sizes and types of manhole frames and covers that it has been decided to call a conference of all interests concerned this fall to develop recommendations which can later be submitted for universal adoption. This action is the outgrowth of a suggestion made in March, 1924, to the Hoover Committee on Elimination of Waste in Industry by the Industrial Association of San Francisco through its consulting engineer, H. K. Hathaway. He pointed out that one locality uses one assortment of sizes, another employs a different assortment, making it difficult for foundries to do more than a local business in manhole manufacture.

Favorable Opinions Expressed

At the request of the committee, the Division of Simplified Practice addressed associations of manufacturers, engineers, public utilities and others asking for their views and comment. From the replies received, the following notes have been prepared:

In addition to promises of co-operation from the American Foundrymen's Association and the Water-Works Manufacturers' Association, many individual manufacturers have agreed to support the movement. It appears from the comment of manufacturers that two or three sizes of manhole are sufficient to cover conditions of heavy and light street traffic loads encountered in large cities and small municipalties. One manufacturer offered the suggestion that only one size of cover and ring be made, but that it be furnished in several different weights. Another pointed out the desirability of having manhole covers interchangeable.

Among the engineering associations canvassed, the only adverse opinion regarding the proposed manhole standardization program was received from the National Electric Light Association, which felt that a standardized product would be undesirable inasmuch as local conditions require special treatment in each case. The association believes, also, that the best service can be secured from local foundries, both as regards regular deliveries and warehouse or other storage facilities.

The city engineers and public utility companies canvassed were practically unanimous for manhole simplification. New Orleans has standardized its manhole frames and covers in so far as sewer service, water service, and subsurface drainage structures are concerned. There is, however, no standard manhole frame agreed upon by the various utilities, such as the telegraph companies, the electric light service and the telephone companies. These utilities prefer a square opening for their underground structures, while the municipal manholes are round.

Many Cities Report

In the Borough of Manhattan, New York, there are 30,000 sewer manholes, 90 per cent or more of these taking covers of one size. About 1½ per cent of the manhole covers are replaced each year on account of breakage or theft. In the Borough of Brooklyn there are 48,000 sewer manhole heads.

Public service companies own nearly 60,000 manhole heads in Manhattan. There are about a dozen public service companies and each has three or four varieties of manhole heads.

In Buffalo it is proposed to change the present depth of the manhole frame from 12 to 10 in. and to machine the cover and cover seat along the edges to prevent rattling.

In Portland, Ore., the manhole covers and frames of the Bureau of Water-Works are interchangeable with those of the city engineer in case of emergency, but they are not identical in pattern. The local public utilities use large heavy covers, which, it is stated, would be a needless waste of metal if applied to sewer manholes.

By the Water Division of the city of St. Louis the belief is held that manhole frames and covers can not be standardized until the different cities of the country agree as to allowable loads on streets and pavements.

Chicago, Ill., uses a reversible curb type of manhole frame, for which many advantages are claimed. In Baltimore a number of difficulties in dealing with foundries were overcome by providing manufacturers of cast iron with municipally owned patterns for filling the city's manhole orders. Baltimore's experience indicates that manhole openings should be at least 2 ft. in diameter and circular.

In Washington, D. C., there are said to be probably a hundred different designs and sizes of manholes and hand holes in use, including square, rectangular and circular. Some of the covers are entirely too light to support the heavy traffic now using the streets, and are being replaced by stronger covers when breakage occurs.

In Jacksonville, Fla., the tops of all manholes are interchangeable.

Lime—National Lime Association, Washington, D. C., has published a 7-p. pamphlet entitled "Building Code Requirements for Lime." The text offers sections suitable for incorporation in new or revised building codes.

Canadian Exhibit Features Building Products

Special Structure Houses Displays of Construction Industry at National Show in Toronto

Report by Engineering News-Record's Toronto Correspondent

AMONG the new features of the Canadian National Exhibition, held at Toronto Aug. 23-Sept. 6, is the "Construction Building" in which are displayed the most modern materials for all classes of building, together with the machinery and appliances used in construction work. This display is under the auspices of the Association of Canadian Building and Construction Industries, organized with the object of co-operating in the adoption of improved methods and standardizing construction activities. There are 97 exhibitors in the building and general construction field, making the showing of materials a comprehensive display.

Concrete and Brick Products

The increasing use of cement as a building material is reflected in the prominence accorded to this feature. The Concrete Products Association of Canada has a spacious booth built up with walls of several types of concrete block construction, enabling those interested to judge of the effect and the advantages of its use. The Canada Cement Co., Ltd., also has a well arranged showing of concrete products and is conducting an active educational campaign by the distribution of information. The London Concrete Machinery Co. Ltd., is represented by several machines used in this branch of industry, including a new model No. 6 mixer, a single drum reversible hoist, a concrete block machine and sewer tile mold.

A number of brick making companies are exhibitors. Shale brick of several types are shown by the Cooksville Shale Brick Co., Ltd., the Harbor Brick Co. Ltd. and the Booth Brick Co. The latter two companies, who have a joint exhibit, also display a line of sand-lime brick. The Milton Pressed Brick Co. Ltd., shows an exhibit of 14 panels of brick laid in walls with approximately 100 bricks to a panel. One of the most comprehensive displays is that of the Don Valley Brick Works Ltd., including a great variety of brick in several colors, lines of special interest being enamel bricks, face wire-cut bricks, and partition tile. The International Quarrymen's Cut Stone Association shows a line of cut stone and the Peerless Artificial Stone, Ltd., exhibits ornamental panels, balusters and rails, together with interior work including a mantelpiece of artificial stone and a cement laundry tub.

The Interlocking Tile Co. Ltd. shows its product which consists of a large hollow brick so designed as to permit of the brick mason placing it on the wall with one hand on horizontal mortar beds. It is manufactured from shale burned to semi-vitrification and is used for bearing walls to replace common brick. The tile is made with deeply grooved keys to hold interior plaster or exterior stucco, or with smooth faces for exposed work. It is claimed to have

great stability due to the 4-in. mortar beds and the patented interlocking system.

WOOD WORKING MACHINERY

Prominent among the machine displays are those of the Elliot Woodworking Co. which shows its No. 6 woodworker designed for operation either in the shop or on the job. It will crosscut or rip to 4-in. thick, joint 6-in. wide, house stair stringers, door and window frames, run moldings, bore, groove, rabbit and perform many other operations. A lighter machine which will do most of the same work is also on display—and also the No. 9 machine designed for heavy work. The Little Bull Dog planer scroll saw and shaper is another interesting feature of the exhibit.

A woodworking machine stated to combine six machines in one and requiring only 3 gal. of gasoline per day to operate is as shown by Weltlaufer Bros. Ltd.

Preston Woodworking Machinery Co. Ltd. is represented by a line of portable woodworking machinery for builders and also show bench jointers, etc.

HEATING EQUIPMENT

Happy Thought Foundry Co. Ltd., of Brantford, shows a furnace specially designed with an air blast attachment for burning soft coal and also equipped with shell bar grates. The special feature of the furnace was devised to meet the possible necessity of using bituminous coal owing to shortage of anthracite. The company also displays a large assortment of hot air furnaces.

Another furnace which is designed so that it will burn either hard or soft coal is the Treasure hot-air furnace shown by the D. Moore Co. Ltd. It is made entirely of cast iron, has an extra large grate area and straight fire pot, the combustion chamber being large to allow for the use of bituminous coal. The radiator is of cast iron and in one-piece rendering the escape of gas impossible and making cleaning easy.

An economical method of heating buildings by forced hot water by the operation of the Atlas circulating pump is demonstrated by the Atlas Engineering and Machine Co. Ltd., which also shows the Atlas heat generators claimed to effect considerable economy in fuel. Toronto Furnace Co. Ltd., displays several types of hot air furnaces including the Novelty hot air and combination heater and a new garbage burner adapted for places where there is no garbage collection.

The exhibit of Mussens, Ltd., includes a gasoline driven No. 4 Smith mixer on trucks and Western grading equipment.

Comprehensive displays of metallic products were made by the Canadian Metal Window & Steel Products Co., Canadian Ornamental Iron Co., Trussed Concrete Steel Co. of Canada, Aikenhead Hardware Ltd., and others.

CONSOLIDATED PRODUCTS CO., INC., New York, dealer in used equipment, has purchased for resale as a whole or in separate units, the plant of the American Hominy Co. at Indianapolis, having a floor area of 200,000 sq.ft.

New Series of Steel Reinforcing Bars Suggested

To the Editor:

On p. 282 of the Aug. 14 issue of *Engineering News-Record* is a brief notice regarding simplification of varieties of steel bars used for reinforcing concrete, proposing that the following sizes only shall be rolled:

SQUARES: ½, 1, 1¼, 1½ in.
ROUNDS: ⅜, ½, ⅝, ¾, ⅞ and 1 in.

These schedules have been largely adopted by manufacturers in the recent past.

In making any kind of a close design it is necessary to use both rounds and squares. The detailing and inspection are both much more arduous than would be the case with a more rational scheme of bar sizes. It is suggested that a series of bars be rolled differing from each other in net area by a constant area in quantity. For instance, a series with the following areas would enormously cut down the amount of work involved in preparing detailed plans.

Bar No.	Net Area, Sq.In.	Bar No.	Net Area, Sq.In.
1	0.10	7	0.70
2	0.20	8	0.80
3	0.30	9	0.90
4	0.40	10	1.
5	0.50	11	1.1
6	0.60	12	1.2

It is often desirable to substitute other bars for those called for, and such a series would make this very easily done. If the numbers of the bars were rolled on the section, as is now done in the case of many reinforcing bars, the inspector can readily obtain a definite area of steel. It is suggested that all these bars be rolled as rounds only.

If we cannot have the metric system, we can at least use a decimal system to its logical limit in this field.

WILLIAM H. ADAMS,
Adams & Adams, Consulting Engineers.
Detroit, Aug. 28.

Business Notes

THE ASPHALT ASSOCIATION, New York, will hold its annual convention in Louisville, Ky., Oct. 13-15 inclusive.

PACIFIC PORTLAND CEMENT CO. last month opened its new plant at Redwood City, Calif. To the present unit, which has a daily capacity of 2,000 bbl. of cement, it is planned to add others from time to time.

AMERICAN ENGINEERING CO., Philadelphia, announces the appointment of the following representatives for the sale of Lo-Hed monorail electric hoist:—H. D. Betts, Syracuse; C. F. Bullotti, San Francisco; A. G. Cary, St. Paul; Chatard & Norris, Baltimore; Colwell & McMullin, Boston; Coon-DeVisser Co., Detroit; H. D. Conkey & Co., Chicago; Dravo-Doyle Co., Pittsburgh; A. Q. Dufour, Milwaukee; Florandin Equipment Co., New York; Fulton Engineering Co., San Francisco; S. A. Gilliard, Buffalo; E. C. Horne Machinery Co., Denver; J-B Engineering Sales Co., New Haven; Lyman Tube & Supply Co., Montreal; J. R. Purser, Charlotte, N. C.; Seeger Machine Tool Co., Atlanta; Solon Jacobs & Co., Birmingham, Ala.; P. E. Wright Engineering Co., Seattle.

STEPHENS-ADAMSON MANUFACTURING CO., builders of belt-conveyors, is constructing an addition to its main plant at Aurora, Ill. The new structure completes the third and final section of the building used to house the steel fabrication department. The original two sections were 300 ft. long and 60 and 80 ft. wide respectively. The new and third section is 80 ft. wide by 300 ft. long. The addition is made up with hollow tile walls, steel sash, wire glass, with reinforced concrete tile roofing equipped with skylights. A new 80-ft. 10-ton crane will travel the entire length of the shop.

CANTON CULVERT & SILO CO., Canton, Ohio, was recently awarded a contract for 10,000 ft. of Imperial riveted Toncan metal culverts. This order, approximately a 20-carload shipment, is claimed to be one of the largest domestic orders ever placed for corrugated iron culverts in the United States. They are to be used under a railroad being built by the Calumet & Hecla Consolidated Copper Co., Calumet, Mich.

To Show Southern Progress by Exposition in North

Fourteen States Will Co-operate in Industrial Display to Be Held in New York Next January

A PICTURE of Southern industrial progress and the natural resources of the South will be brought to the North next January through the medium of the Southern Exposition, to be held in Grand Central Palace, New York City, Jan. 19-31, 1925. The display, the first of its kind ever staged north of the Mason and Dixon line, will represent the activities of fourteen Southern states which have completed plans for the exposition through a co-operative organization of local chambers of commerce. Governor E. Lee Trinkle, of Virginia, has accepted the position of honorary president of the exposition, of which the direct management is in the hands of William G. Sirrine, of Greenville, S. C.

It will be the purpose of the exposition to show what the South has done and is accomplishing. The exhibits will include products of factories, industries, mines, agriculture and horticulture; the means and equipment for transportation, power, sanitation and education; pictures and specimens of natural resources. The exposition will occupy more than 90,000 sq.ft. of floor space, of which about 7,000 sq.ft. will be allotted to each state. Exhibitors will be grouped according to states. The allotment of space and the placing of exhibits is under the direction of Col. Joseph Hyde Pratt of Asheville, N. C., former state highway engineer and at present director of the North Carolina Geological and Economic Survey.

Equipment and Materials

Crawler Attachment for Motor Truck Wheels

In last week's issue, p. 400, appeared a description of a new continuous crawler tread attachment for motor truck wheels called the Truk-Trak. The name of the manufacturer of this equipment was erroneously given as the Silver Casting Co.; the name should have been the Sivyer Steel Casting Co., Milwaukee.

New Pipe Threader Has Electric Motor Drive

A new electric pipe threader designed to reduce the time and cost of cutting or threading pipe has just been placed upon

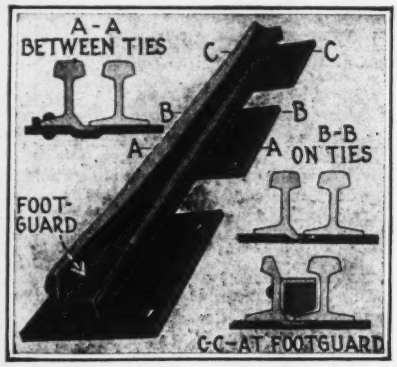
the market by the Oster Manufacturing Co., Cleveland. The machine may be used on pipe from ¼ to 2 in. in diameter. A built-in vise aided by an auxiliary chuck, both of which are self-centering and self-locking, hold the pipe securely in place while the die-stock is being turned by the motor. In addition to threading the pipe this machine does the cutting off and the screwing up of the fitting. The gears are completely encased and are run in oil.

The machine is driven by a ½-hp. Westinghouse motor which is furnished with a 10-ft. cord and a plug which may be screwed into an ordinary light socket. The machine is portable and may be mounted on a service truck eliminating the necessity of bringing each piece to the workshop to be threaded.

Guard-Rail for Railroad Frogs

A rolled steel guard-rail which is held in place by the running rail without the use of bolts, clamps, spacing blocks or other fastenings, is a track device which has been brought out by the Bethlehem Steel Co., Bethlehem, Pa., for use at frogs and turnouts. This guard-rail is of a special rolled section, having the inner flange of its base lower than the outer flange, so as to fit under the base of the running rail. The weight on the latter rail holds the guard rail against any tendency to rise or to turn outward under pressure of the wheel flanges, while a rib on the middle base plate prevents any lateral displacement.

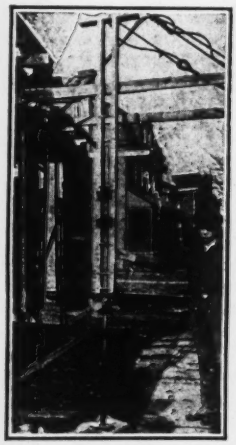
The head of the guard rail is planed away at the ends to give a tapering entrance to the flangeway. Three heavy base plates, each resting on two ties,



carry both the guard rail and the running rail. These plates and the steel footguard at each end are riveted to the rail at the shops, the guard being shipped as a complete unit ready to be spiked in place. The guard rail is ordinarily made 9 ft. long, but it can be made of any desired length and to fit any specified spacing of ties. Notched or graduated spike holes in the base plates provide for fastening track rails of different widths of flange.

Adjustable Shore for Forms

Adjustability to different heights of support and secure locking in the position desired are features of the Atlas shore for concrete forms manufactured by the Roos-Meyer-Hecht Co., Cincinnati. This device, shown in the accompanying photograph, consists of a timber frame sliding on a pipe, which, by means of a spring and locking plate, may be set to heights of from 8 to 14 ft. 6 in., thereby giving a 6½-ft. range of adjustment.



The locking plate is a channel shaped member of steel pivoted by a cross pin through the 2x4-in. member and held in a canting position to engage and hold the pipe by a stiff coiled spring. The shore locks itself automatically at any position on the upward movement of the outer frame. Unlocking is accomplished by tapping the locking plates downward, compressing the spring, and releasing the shore from its load.

The outer member or frame is pushed up along the pipe by hand and the final or tight adjustment under the load is obtained with a special jack having a swiveled collar which is slipped around the pipe.

Shovel Crawls 28½ Miles

To reach a road construction job in the Shenandoah Mountain section of Virginia a Northwest gasoline shovel, operating under its own power, made a trip of 28½ miles. Equipped with crawler traction, the machine left a railroad siding at Staunton, Va., Friday, May 9, and was on the highway construction job by noon Wednesday, May 14, the actual traveling time of the trip being 35 hr. The journey involved the traversing of mountainous country and the crossing of a stream where water 4 ft. deep was encountered for a distance of 600 ft.

Shovel Loader for Attachment to Fordson Tractor

For attachment to a Fordson tractor the Mandt Co., Keokuk, Iowa, has devised the shovel loader shown in the accompanying photograph built in two sizes with ¾ and ½-yard buckets. For the dipper stick and shovel a crane arm with hook can be substituted.

The framework of the loader is of

structural steel with heavy gusset plates and steel castings on the top and bottom swinging brackets. With ¾-yd. bucket the weight of the attachment is 1,820 lb. The machine has a lift of about 8 ft.

In operation the bucket is filled by being pushed into the pile by the tractor and is raised by power from the tractor engine. The outfit is particularly adapted for loading earth, sand, gravel, coal or crushed stone. The larger ½-yd. bucket is recommended for lighter material, such as snow, ashes, cinders, or loose dirt. Swinging is accomplished by a bull-wheel in the form of a semi-circle through the open end of which the dipper arm passes when raised or lowered.

Publications from the Construction Industry

Concrete Mixers—LEACH CO., Oshkosh, Wis., has published in the form of a 16-p. illustrated pamphlet a report by the Robert W. Hunt Co. of inspections of the design and operation of a number of 7-S concrete mixers made by different manufacturers.

Material-Handling Equipment—GIFFORD-WOOD CO., Hudson, N. Y., features its material-handling equipment, including elevators and conveyors of various types, in a newly published 24-p. illustrated pamphlet. Application of equipment to automobile factories, shipping departments, steamship terminals, and industrial plants is shown.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Steel and Cement Output Gaining—Seasonal Decline in Brick Production

Early Closing of Yards May Cause Brick Scarcity in Spring—Warehouse and Mill Stocks Moderate

Steel—The August ingot output as calculated by the American Iron and Steel Institute for all companies in the United States, reached 2,541,501 tons, compared with 1,869,416, during July. March attained the highest total reached so far this year with 4,187,942 tons. The August, 1923, total was 3,695,788 tons. Although there was no increase in the number of working days at mills during August, there was a substantial gain in the approximate daily output of steel.

Ingot production figures for the first eight months of this year and last, are as follows:

Month	1924 Tons	1923 Tons
January	3,633,639	3,841,095
February	3,809,185	3,471,843
March	4,817,942	4,066,680
April	3,333,535	3,963,736
May	2,628,261	4,216,355
June	2,056,466	3,767,256
July	1,869,416	3,531,458
August	2,541,501	3,695,788
8 months	24,059,945	30,554,211

Lumber—Production continues to be substantially less than that of a year ago and a little under normal, according to the National Lumber Manufacturers' Association. A total of 344 mills reporting for the week ended Aug. 28, show an all around drop in the lumber movement compared with the week preceding. Production and demand are both slower than a year ago, while shipments are nearly 2,000,000 ft. heavier.

A weekly comparison of lumber movements follows:

Mills	Week Ended Aug. 28 Ft. b. m. 344	Corresponding Week in 1923 Ft. b. m. 388	Preceding Week in 1924 Ft. b. m. 374
Production	217,874,202	253,414,423	228,942,410
Shipments	230,105,896	228,152,505	245,512,944
Orders	219,839,820	227,832,471	236,458,681

The following table shows the lumber movement for the first thirty-five weeks of 1924, compared with the same period in 1923:

	Production	Shipments	Orders
1924	8,145,554,876	8,099,415,423	7,849,041,171
1923	8,354,194,351	8,483,834,458	7,927,090,930
1924 decrease	208,639,475	384,419,035	78,049,759

Cement—Production and shipments are at the highest levels on record, according to the Geological Survey, and though mill stocks have been decreasing rapidly since March, 1924, they are greater now than at the corresponding season of any previous year. The heaviest reserves are in the district embracing Eastern Pennsylvania, New Jersey and Maryland, with Eastern Missouri, Iowa and Minnesota next and Colorado and Utah coming last with only 188,000 bbl. between the two states.

Brick—Orders on books of the Common Brick Manufacturers' Association of America at the beginning of August were only about 17 per cent below those of July 1. This, it is claimed, is due principally to the fact that August is not usually the month for starting new operations. Fewer brick are being moved from yards, throughout the country, although increased deliveries are expected during September and October.

In New York City, the steel erectors' strike has greatly lessened brick consumption. The increased production plus imports, naturally resulted in a glutted market. The early shutting down of plants in the Hudson River district is preventing any further oversupply and may even serve to cause scarcity in the spring, before the 1925 brick begins to come into the market.

The brick situation is shown in the following table:

1923	Burned Brick On Hand M.	Unburned Brick On Hand M.	Brick Moved From Yard During Month M.	Orders On Books M.
Aug. 1	179,574	59,474	...	342,719
1924				
June 1	223,458	70,802	163,298	394,156
July 1	258,474	72,725	158,753	366,098
Aug. 1	231,182	86,722	149,622	314,538

Both warehouse and mill stocks of basic building materials are moderate. The same is not true, however, of industries where there has been overexpansion, such as in textiles, shoes, clothing, automotive equipment and coal.

It would hardly pay the consumer to place large orders with warehouses if mills were heavily loaded with reserve stocks. Mill stocks being moderate, however, present production schedules are geared to actual orders on books. Shipments from mills, therefore, are governed by the time involved in manufacturing the material. Warehouses are absorbing all single or less-car-lot tonnages.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

ocks on hand in approximate figures, example: (Lumber, Denver, 40,000,000 ft.); time required for delivery of carload lots to city job, example: (Hollow tile, Atlanta, deliveries take 4 to 5 days); and stocks on hand in general terms, example: (Sewer pipe, Philadelphia, stocks normal).

	Los Angeles	San Francisco	Denver	Minneapolis	New Orleans	Atlanta	Philadelphia	New York
Sewer pipe	Heavy demand; good del.	Large reserves	Barely keeping up with orders	Stocks ample; mill del. prompt	Stocks plentiful; demand good	Mill del. takes 4 to 5 days	Stocks normal	Dealers' stocks usually small
Cement	Prompt mill del.; demand active	Dealers' stocks in good condition	Stocks in good shape	Ample on hand	Sufficient	75 to 80 cars on sidings	Mill del. sufficient to meet all demands	Stocks larger than years ago despite heavy shipments
Lime	Kilns busy; demand brisk	Enough on hand	Sufficient	Quick del. from kilns	Adequate	75 to 80 cars; enough	Kiln del. taking care of demand	Dealers' stocks usually small
Common brick	Demand slower	Enough	Plenty; 5,000,000	Good supply near at hand	Normal	Plentiful	Yard stocks small but ample	Many yards closing early; recent excess being rapidly absorbed
Hollow tile	Light demand	Sufficient	Del. week behind orders	Obtainable in short order	Ample	Del. take 4 to 5 days	Del. as needed	Dealers' stocks usually small; prompt del. by rail and water
Lumber	Mills behind in orders	Plenty	Well stocked; 40,000,000 ft.	Below normal; about 130,000,000 ft.	Reserves low; demand slower	Plenty	Yards well stocked with all grades	Stocks smaller than year ago; demand slower
Asphalt	Supply lower	Large quantity available	Limited quantity on sidings	Quickly obtainable from source	1,150 tons available; 1,500 needed	100 cars; sufficient	Demand small; stocks small	Ref. near city
Structural steel	Demand steady; del. good	Heavy warehouse stocks of bars	Warehouses well stocked	Local warehouse stocks low as they are allowed to get	Plenty; demand below normal	4 to 5 cars; plenty for dealers' reserves	Warehouse stocks limited	Slow demand for structurals

Foreign Projects of Interest to Americans

Further information is available on these projects at the Bureau of Foreign and Domestic Commerce or its district co-operative offices, when a reference number is given.

Irrigation in Mexico. A concession has been granted to use the waters of Lake Santiaguillo and the Guatimape River to irrigate a section of over 12,000 hectares. Reference No. 137,879.

Concrete pier for Manzanillo. The pier is to be 220 meters long, 68 meters at the base and 25 meters at the outer end. There will be four railroad tracks, three reinforced concrete warehouses and cranes for loading and unloading. Reference No. 138,229.

Extensive paving plans for suburbs of Buenos Aires. Plans for the paving of 1,096 squares of streets in the city and suburbs, most of which will be of stone block. Project calls for the expenditure of 3,000,000 pesos (1 paper peso = $0.32).

Harbor improvements planned for Quebec. A scheme for the development of the port of Quebec, involving an expenditure of some $10,000,000, has been presented to the Federal Government by the Quebec Harbor Commission. The House of Commons has voted a preliminary sum of $500,000. Reference No., 138,913.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 139 to 153, are the following:

Hotel, Columbus, O., to Wells Constr. Co., $4,000,000.

Street railway, Toronto, Ontario, to J. Simpson, $1,000,000.

Office building, Detroit, Mich., to M. Barry Co., $1,000,000.

Library building, Los Angeles, Calif., to Clinton Constr. Co., $1,352,528.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 4, the next, on October 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	$3.80	$4.20	$3.00	$3.35	$4.00	$3.40	$3.35	$4.20
Structural rivets, 100 lb.	3.75	4.35	4.90	—3.10	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.87½	3.35	3.25	2.70
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.05%	36%	36.80@49.10%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	60.60@61.60	+55.50	60.00	56.20@57.20	55.50	68.00	58.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	—2.25	2.75	1.85	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	3.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+58.00	35.00	57.20	+55.00	37.75	34.75	—29.00	+24.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.60	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.45	1.85	1.50	1.40	2.70	2.15	2.80	10.50
Common brick, delivered, 1,000	—17.00	11.00	—13.10	12.00	+14.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	+.1004	.11	.089	.08	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	+.1004	.11	.089	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	—1.04	+1.14	+1.23	—.94	+1.15	+1.25	+1.14	1.13	1.01
Common Labor:									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.30@.50	.82½	50@.55	.35@.50	.50	.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. The price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.96. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

Advances predominate in this week's price situation. Since the first of the month declines have been in the minority. Particular strength is noted in c.-i. pipe, pine and fir timbers, hollow tile and linseed oil.

Of nine cities reporting weekly to *Engineering News-Record* but four announce declines in any of the basic building materials. A slight drop in ¾-in. gravel and common brick occurred in Dallas; linseed oil fell in New York and Chicago and fir timbers declined $2 per M ft. in San Francisco.

Building construction in Seattle during August attained the highest total in the city's history. Business buildings, apartments, factories and warehouses far exceeded the value of residence permits. A similar gain in building permits occurred in Tacoma, comparing August, 1924, with the corresponding period last year. Building operations registered a gain last month in St. Louis, compared with August, 1923. Reports from Los Angeles and Canadian points, however, show declines compared with 1923.

Seattle hod carriers recently gained an advance of 50c. per day, making the present wage $8. Plasterers were similarly advanced to $11; painters to $8.40 and lathers and plumbers to $10 per day. Unemployment in other lines in Seattle is not reported as being a serious problem at this time.

In the Dallas district, however, the common labor situation is just the opposite, owing to an acute shortage of help. Bumper cotton crops in western Texas are taking thousands of men away from building operations.